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ACCEPTANCE TEST REPORT
(MI-74067-009-00)

SVWS Access Arm, SA 6A
(Serial Number AA-09-03)
(Drawing 75M08129-13)

April 26, 1973

Acceptance Test Report
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SVWS Access Arm
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by

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ACCEPTANCE TEST

OF THE

SVWS ACCESS ARM

SKYLAB 1

ABSTRACT

Acceptance tests were conducted at Kennedy Space Center of the Saturn Vehicle Workshop Spacecraft Access Arm and related equipment. The tests were conducted to prove complete system capability to operate satisfactorily under conditions required to support spacecraft operations and activities. These tests were conducted in two parts. The first, performed by Bendix Launch Support Division between April 1972 and June 1972, qualified the new environmental chamber. The second portion was conducted by Boeing after the arm was installed on the tower.

The SVWS Access Arm, serial number AA-09-03, is a Command Module Service Arm, S/A 9, which was removed from the mobile launcher and modified to support the SVWS operations. The C/M environmental chamber was removed and a completely new chamber was installed. The retract system was redesigned to remove the automatic/remote control capability and replaced with a local manual control.

The SVWS Access Arm System was successfully tested and supported spacecraft processing without major problems.

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SVWS ACCESS ARM

SKYLAB 1

SUMMARY

The SVWS Access Arm is a Command Module Service Arm which was removed from the mobile launcher and modified to support the Skylab 1 launch. This modification was accomplished by the Bendix Launch Support Division under the direction of NASA-KSC Design. These design changes included removing the Apollo command module environmental chamber and replacing it with a new chamber designed to mate with the workshop spacecraft. Also redesigned was the retract control system. All automatic and remote control capabilities were removed and a local/manual system was installed to operate the arm. The arm was relocated from the 320-foot level of the mobile launcher to the 240-foot level in order to align with the hatch of the workshop.

Tests were performed in two separate sections. The first portion of the testing was conducted by Bendix Launch Support Division and consisted of qualification tests on the new environmental chamber. A description of this portion of the testing and the results of the tests are contained in the Bendix Test Report which is included in this report as Appendix A.

The second part of the testing was performed after the arm was installed on the tower. These tests were performed per work orders prepared by Boeing Aerospace Company and are listed below.

Work Order	Title
M2132-52314	Adjust Arm Extend Angle
M2132-52768	Final Arm Alignment
M2132-54226	Pneumatic and Hydraulic System Leak and Bleed Test
M2132-54669	Arm Retract/Extend Test

These last tests were completed with no problem and the results compared with the desired results of 79K00069. A detail of each test and its results is given later in this report.

SECTION I. INTRODUCTION

Testing of the SVWS Access Arm was conducted for the Launch Support Equipment Engineering Division, KSC, by Boeing Aerospace Company under Launch Vehicle Operations, KSC, directions.

This report presents the results of the testing performed on the SVWS Access Arm (drawing 75M08129-13) and related equipment. The first portion of the report contains information and test results on the total arm systems. Details of the environmental chamber test are given in Appendix A.

All testing was accomplished per and results comply with 79K00069.

SECTION II. DESCRIPTION

A. Test Hardware

1. The SVWS Access Arm and associated hardware were tested for use to support SVWS spacecraft operations at KSC, Florida. The hardware tested included the access arm and hinges, environmental chamber, and control panel. The SVWS access arm is mounted at the 240-foot level of the mobile launcher. The arm supports an environmentally conditioned chamber which provides access to the side hatch of the workshop spacecraft. This access is ued by service personnel for equipment installation in the spacecraft and testing the spacecraft during processing.

2. Major Assembly

a. Truss Assembly (Drawing 75M10490-1)

The truss assemblies were not modified and are the same as used for the command module access arm.

b. Environmental Chamber Assembly (Drawing 79K00728-1)

The environmental chamber is a controlled atmosphere room installed on the end of the arm to provide access to the SVWS. A detail description is given in Appendix A, Section 11-A.

c. Hinge Assemblies (Drawings 76K00253 and 76K00254)

The hinge assemblies were not modified and are the same as used for the command module access arm.

d. Service Lines (Drawing 75M10508-1)

The service lines on the access arm provides the following services to the environmental chamber and SVWS.

(1) Air conditioning.

(2) GN2 Purge.

(3) GN_2 Supply

(4) GHe Supply

e. Related Equipment

(1) Tower-mounted Arm Support (Drawing 75M07164-2)

(2) Latchback Assembly (Drawing 75M12387-1)

(3) Shock Absorbers (Drawing 75M12552)

(4) Arm Extend Lock Assembly (Drawing 75M12139

All of the above equipment was not modified and is the same as used for the command module access arm.

f. Control Panel Assembly (Drawing 79K00727)

The panel requires 750 psi GN2 and 3000 psi hydraulic fluid in order to perform its required functions. All controls on the panel are manual and control the following arm system hydraulic and pneumatic pressures.

(1) Arm Extend Lock Cylinder Pressure.

(2) Hinge Actuator Pressure.

(3) Latchback Cylinder Pressure.

B. Test Facility

The arm system testing was conducted after the arm was installed on the mobile launcher at the 240-foot level. The only support that was required was the tower facility's 750 GN2 and 3000 psi hydraulics. The flight hardware spacecraft was used for the chamber fit check and first mate.

SECTION III. TEST PLAN

The basic test plan used for testing was the 79K00069 Design Test Plan. There were no deviations from this test plan during the testing of the total arm systems.

SECTION IV. TEST RESULTS

A. Basic Arm Modification

Command Module Access Arm, S/A 9, was removed from the mobile launcher and transferred to Hangar AF at the Cape Kennedy Air Force Station. The arm was turned over the to the KSC-NASA Design Group to be modified for use in support of the SVWS spacecraft operation. A new environmental chamber was built to replace the Apollo chamber. After the arm modification was completed, the chamber was mated to the arm in the transfer aisle of the VAB. Boeing Aerospace Company supported the preparation of the arm by installing the upper and lower hinges per work order M2132-50228. Testing was then completed on the chamber (see Appendix A) and the arm was installed on mobile launcher 2 at the 240-foot level.

A completely new arm control system was designed and installed on the 240-foot level of the tower. Three systems are controlled with manual valves and include the latchback, arm extend lock and arm retract systems. Piping was connected between the control panel and the arm after the installation of the arm was completed.

B. Receiving and Inspection

An inspection of the arm was performed when the arm was received by Boeing Aerospace Company. Thirty-one items were noted in this inspection and an NCR (N-279717) was written to document these discrepancies. All discrepancies were dispositioned and corrected.

C. Additional Modification

Some minor modifications were required after the arm was received by Boeing Aerospace Company. The mods were accomplished on the following work orders:

M3132-53822 - Remove hangers from dock seal support assemblies.

M2132-53047 - Install quick release pin in the access walkway handrail.

M2132-52684 - Re-position angle bracket inside environmental chamber.

D. Testing

All of the arm system tests were accomplished per work orders in accordance with the Design Test Plan, 76K00069. These tests are listed below with the test objective, test results and problems encountered.

1. Adjust the Arm Extend Angle - W/O M2132-51314

a. Test Objective

The purpose of this procedure was to make rough adjustment in the height of the arm and extend angle of the arm. The angle of the arm in the extended position was to be set at 189° 33' from the fully retracted position. The height of the arm tip was to be adjusted 12.5 ± .125 inches above the 240-foot level. Two clearances were required to properly align the arm. The first clearance of four inches maximum is required between the roof of the VAB "C" platform and the bottom of the environmental chamber. The second clearance is 2 ± .125 inches between the bottom of the extension platform inside the chamber and the chamber floor.

b. Test Results

All adjustments complied with drawings 79K00069 and 79K02677, sheets 1 and 3. The extend angle of the arm was adjusted to 189° 33'. The elevation of the arm was first set at 12.5 inches above the 240-foot level of the mobile launcher; further height adjustment provided 4.1 inches clearance between the chamber and "C" platform roof. The chamber extension platform clearance was 2.0 inches.

c. Problems Encountered

No problems were encountered during this test.

2. Final Arm Alignment - W/O M2132-52768

a. Test Objective

Final adjustment of the arm per sheets 2, 4, and 5 of 79K02677 were made after the vehicle was erected. The extend angle of the arm was changed so that the distance between front of the chamber and the vehicle would be 28.65 ± .03 inches. The height of the arm was adjusted so that the height of the chamber coupler and the vehicle hard point are equal +.125/-.250 inches. This work order also checked out the operation of the dock seal blowers and verified the dock seal bearing area.

b. Test Results

A small adjustment was made in the extend angle so that the final dimension between the vehicle and chamber was 28.65 inches. The arm was also raised so that the final position of the coupler was .250 inches below the vehicle hard point. Both of these measurements conform to the other drawing requirements. A measurement was taken on the offset of the coupler horizontal to the vehicle hard point. It showed the arm was three inches too long. A KSC Request (#KMB-513-004-R1) was written requesting design to evaluate this condition. Design's reply was the horizontal misalignment of three inches can be taken care of by the coupler and extension platform tracking capability. The assembly has been tested to ± 11-1/2 inches; the requirement is to track ± 6 inches. Both blower motor operated properly and the dock seal touched the vehicle in the area provided.

c. Problems Encountered

No problems were encountered during this test.

3. Pneumatic and Hydraulic System Leak and Bleed Test - W/O M2132-54226

a. Test Objective

This test was performed to verify the proper operation of the pneumatic and hydraulic systems of the arm. The latchback pneumatic system was pressurized and checked for any audible leaks. The latchback cylinder was actuated to verify that the pawls would go up and down as required. The arm extend lock and the arm retract/extend hydraulic systems were filled with fluid and visually checked for leaks.

b. Test Results

All systems were pressurized or filled with hydraulic fluid and no leaks were noted.

c. Problems Encountered

No problems were encountered during this test.

4. Arm Retract/Extend Test - W/O M2132-54669

a. Test Plan

After the mobile launcher and vehicle were transferred to pad A, the arm was retracted and extended to verify the operation of all the arm systems. The arm was first retracted and movement of the arm was observed for any interferences and satisfactory movement of cables and flex hoses in the upper hinge area. With the arm almost fully retracted, measurements were taken for proper latchback alignment. The arm was then fully retracted and the arm was checked for parallelism with side 4 of the tower. The hydraulic system was bled with the arm retracted and after it had been re-extended. One retract cycle and one extend cycle was made with the hydraulic return valve fully open to measure the time required for these cycles. The arm was secured in the retracted position at the end of the test.

b. Test Results

The arm was retracted and extended with little difficulty. The arm-mounted latchback skid was repositioned to line up with the tower-mounted skid. The tower skid was raised with shims 9/16 inches in order to make contact with the arm in the fully retracted position. No adjustment was required on the shock absorber striker plates since the arm is only 1/4 inch (in the expended direction) from being parallel to side 4 of the tower. During the timed operations, the hydraulic return valve was fully open and the arm extended in 2 minutes, 42 seconds, and retracted in 2 minutes, 43 seconds.

c. Problems Encountered

There were only two problems encountered during this test. The first was very minor and only required repositioning some electrical and OIS cables to allow sufficient slack in the upper hinge. With the arm approximately 30% retracted, the handrails on the back of the arm interfered with the lower arm extend lock. This interference was removed on the inner handrail by shifting the handrail up as far as the mounting bolts would allow. Since the outside handrail could not be moved enough, NCR N-272436 was written and the bottom of the handrail was shimmed out 1/4 inch. This eliminated the interference. No other problems were encountered.

5. Special Test

a. Test Plan

A special test was run during the Swing Arm LCC Integration Test to determine the relative motion between the environmental chamber and the vehicle. The chamber was instrumented with linear transducers to measure the following:

Vehicle to Chamber (Axial)

Vehicle to Chamber (Perpendicular)

Chamber to Platform C Roof (Axial to Vehicle)

Chamber to Platform C Roof (Perpendicular to Vehicle)

Chamber to Platform B (Parallel to Vehicle)

Information from this test was used to determine whether or not the chamber would remain connected to the vehicle during the Swing Arm Overall Test.

b. Test Results

All data from this test is given in Appendix B. Movement of the chamber was less than one inch in any direction. This movement is much less than the tracking capability of the chamber so the chamber was allowed to remain connected during the overall test.

c. Problems Encountered

There were no problems encountered during this test.

SECTION V. CONCLUSIONS AND RECOMMENDATIONS

The SVWS Access Arm as modified and tested satisfactorily supported spacecraft operation in the VAB. The arm is currently on standby at the pad in case of an equipment malfunction onboard the spacecraft.

One problem did occur in the VAB near the end of the spacecraft processing. A blower motor heated up and had to be turned off. An NCR was written and the defective blower was disconnected so it could not be turned on. A new blower was ordered and will be installed when it is received.

Since all tests were completed satisfactorily and the spacecraft operation supported with no major problems, no new modifications or changes to the arm are recommended at this time.

SVWS Access Arm will satisfactorily support the Skylab 1 launch.

APPENDIX A

ACCEPTANCE TEST OF THE SVWS ACCESS ARM ENVIRONMENTAL CHAMBER SKYLAB I

By

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ABSTRACT

The acceptance testing of the SVWS Access Arm Environmental Chamber was based on the requirements of ECN 74067, MIP-001-00 for Mobile Launcher 2, and described in detail under Item 5 of the Modification Instructions. The test criteria, as referenced in this MIP, was outlined in 79K00069 with EO's 1, 2 and 3.

A Bendix Acceptance Test Procedure -001 was developed to comply with the performance of test criteria functions assigned to Support Operations/Bendix and also to describe supporting functions and equipment requirements.

Test operations were performed to evaluate the results of a chamber load proof test, extensible platform load proof test, platform coupler operation, and dock seal inflation and tracking test. Load cells and strip chart recorders were utilized to determine compression or tension loads at specific areas of a vehicle skin panel during the tracking operation. All tests on the chamber were performed on the chamber support frame located in an assigned area outside Tower F of the VAB Transfer Aisle.

One major delay occured for a period of one week during the test program to modify the length of the dock seal. Other problems encountered required modifications during test operations and will be discussed in detail under Section IV, Test Results.

The Environmental Chamber as modified during the test is acceptable for operational use provided the proposed recommendations are incorporated as described under Section V.

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ACCEPTANCE TEST OF THE SVWS ACCESS ARM ENVIRONMENTAL CHAMBER SKYLAB I

SUMMARY

The procedure shown as Reference A describes in detail the sequence of operations performed and was observed by on-site representatives from DD-MDD-31, SO-OPN-2 and LV-MEC-11. Procedure changes were made during the test as required and approved by the on-site DD-MDD-31 representative.

During the test the original dock seal required removal, modification for additional length and re-installation on the chamber. This delay was necessary in order to provide an adequate seal on the vehicle skin panel during tracking operations.

The initial attempt to record load measurements resulted in alignment problems with the skin panel, test fixture and the interconnecting load cell linkage. Critical dimensions were not specified on the applicable drawings and after evaluation of the requirements, a re-alignment was performed on all load cell attaching linkages. The re-alignment adjusted the projection of the vehicle hardpoint beyond the vehicle skin to the correct dimension of 4.97 inches. All load measurements were obtained by direct readout on strip chart recorders during tracking operations.

SECTION I. INTRODUCTION

The test program was performed to determine compliance with design specifications after fabrication and assembly of the Environmental Chamber in the Bendix Technical Shops. The program also demonstrated that the equipment satisfactorily performs its intended function and is structurally adequate. This test report is considered part of the overall service arm modification program under ECN 74067 and will be included in the Hardware Data Package for the completed ECN.

This report presents the results of the acceptance testing of the chamber prior to installation on Service Arm 6A. The test results comply with the requirements of the Test Criteria Document (79K00069) Section I and Section II, Paragraphs A, B, C and D only. Sections II E, Section III and Section IV are to be performed by Launch Vehicle Operations directorate. The tests were conducted from April 3 to April 24 and the chamber was installed on the service arm on April 26, 1972.

SECTION II. DESCRIPTION

A. TEST HARDWARE

1. General

The environmental chamber consists of a hard shell enclosure with an internally mounted extensible platform that connects to the Orbital Workshop vehicle hardpoint; an inflatable dock seal for environmental protection; interior lighting, communications and supporting equipment. This chamber is mounted on the end of the SVWS Access Arm (6A) for servicing the OWS Spacecraft.

2. Major Assemblies

a. Chamber Structure (Drawing 79K00728-1)

The main portion of the chamber is the enclosure that provides conditional access to the OWS and storage for tools and equipment. Access to the chamber is provided through the service arm structure or through the enclosure installed on the roof of the VAB Extensible Platform C in High Bay No. 2. Entry to the OWS is provided by a third chamber opening on the vehicle side which is covered by a dock seal. Environmentally controlled air is ducted to the chamber and vented by louvers that provide proper air pressure inside the chamber.

b. Extensible Platform Assembly (Drawing 79K00748)

This platform is contained within the chamber and supported by four support rods attached to the ceiling. The assembly is equipped with a moveable tip containing hand rails, a coupler assembly to attach to the vehicle, and is secured by two steel lanyards holding the platform away from the chamber opening.

c. Dock Seal Assembly (Drawing 79K00758)

Enclosure of the work area between the chamber and the vehicle is accomplished by an inflatable fabric bellows that preserves the conditioned environment within the chamber. Six interconnected convolutes of fabric are supported by three rods above the dock seal to facilitate inflation and alignment to the vehicle and also provide independent tracking of vehicle motion.

During periods of no activity, a transparent weather panel is zipped to the opening and the entire assembly is held secure by straps attached to the chamber.

3. Operational Sequence

Actual operating conditions were simulated during the coupler actuation test only and although subject to later refinement, the operational sequence will require a minimum of three personnel to perform the following:

a. Remove dock seal weather panel.

b. Release all securing straps from the dock seal and inflate with both blowers.

c. Fold down moveable tip of extensible platform and open personnel gates.

d. Disconnect restraining lanyards and manually guide platform to center nominal position.

e. One operator will be required to unlock, align, and engage the coupler to the vehicle while the remaining two operators guide and stabilize the platform until the coupling operation has been completed.

B. TEST FACILITY

Vehicle tracking was simulated by a specially equipped forklift capable of moving a vehicle skin panel within the 24-inch motion envelope. Load cells were installed on both sides of the vehicle hardpoint and an additional four load cells were located at each corner area of the OWS door location. Supporting hardware was designed to measure skin panel loads independent of loads imposed on the hardpoint.

Strip chart recorders and signal conditioning equipment for the output of each load cell were installed in a moveable rack. All data was displayed on a real-time basis without discrete signals.

Arrangement of test equipment is shown in Reference D and H in a test area established outside VAB Tower F in the Transfer Aisle.

SECTION III. TEST PLAN

The performance of the complete test program is described in detail in the Acceptance Test Procedure -001.

Deviations or additions to the procedure pertained to the following:

1. Chamber Load and Proof Test - An additional dial indicator was utilized directly below the prime point of deflection measurement to correlate data at each load point, however, readings taken at this point show deflection of the chamber and support frame assembly.

2. Dock Seal System Test - The extensible platform remained coupled to the vehicle skin panel when load measurements were recorded due to the inflated dock seal. This condition simulated actual operating conditions with the total system in operation. The procedure requirements specified disconnecting the extensible platform and obtaining data with the inflated dock seal only.

SECTION IV. TEST RESULTS

A. SYSTEMS TEST

1. Test No. 1 - SVWS Chamber Load and Proof Test

a. Test Objective

To determine that the chamber will support a load twice its rated live load of 1200 pounds with no permanent deformation.

b. Test Results

Test weights of 50 pounds each were uniformly loaded on the chamber floor to simulate 200% of the rated live load of 1200 pounds. Deflection of the chamber was measured from the top outside surface of the corner diagonally opposite from the arm/chamber mating flange. Dial indicator readings were taken at 25, 50, 80 and 100% of the 2400 lb. test load installation and also during load removal to determine deflection and any permanent deformation of the chamber structure.

The maximum deflection obtained with a 2400 lb. load was .017 inches and held for a five minute period. Data obtained at zero load conditions prior to and after the loading sequence indicated no visual deformation; yield, or structural failure. Incremental deflection at the various load points are shown in Reference C.

c. No Problems were Encountered.

2. Test No. 2 - Extensible Platform and Tracking Test

a. Test Objective

(1) To determine that the platform will support a load twice its rated live load of 600 pounds with no permanent deformation.

(2) To determine that the platform will satisfactorily track the vehicle and that no interference exists between the platform and chamber structure as tracking occurs.

b. Test Results

(1) The platform secured within the chamber, was extended in the normal operational position and uniformly loaded with 1200 pounds of test weights including 200 lbs. on the moveable platform tip. The loading sequence was performed at 50, 80 and 100% of the maximum load. Visual inspection of the platform assembly with full load indicated no structural anomalies.

(2) The loaded platform was manually moved through the four tracking points of the motion envelope maintaining the platform centerline parallel to the chamber centerline but adequate clearance could not be maintained with the chamber opening.

NOTE: Reference to the tracking positions are as viewed from inside the chamber facing the vehicle skin.

c. Problems Encountered

During the tracking sequence to the extreme right or left position (Points F and B, Reference D) interference was found between the platform and the dock seal retaining bar on both sides of the chamber opening (Reference I). Physical measurements of the platform width and the chamber opening indicated that a maximum side displacement of 11 3/4 inches from the chamber centerline would cause contact with either side when the platform was moved from center nominal position. The interference problem was eliminated if the platform was placed in a skewed position.

Tracking away from the chamber (Point E) also resulted in interference between the forward platform support rods and the top structural edge of the chamber opening. The clearance between the platform and the chamber floor was reset from 4-inches to 2-inches to increase the radius of swing. The test point was re-run and although the interference was eliminated the actual clearance between the support rod and the chamber opening was less than 1/8 inch.

Prior to removing the 1200 pound load a second inspection of the platform assembly was performed and no visual defects were found.

3. Test No. 3 - Coupler Actuation Test

a. Test Objective

To ensure that the coupler can be actuated from the platform, operation is smooth with no binding of components, overcenter locking can be readily effected and that jaws of coupler properly engage the vehicle hard point ball.

b. Test Results

Actuation of the coupler assembly was tested at each of the four tracking points and center nominal positions by performing the complete operational sequence of the extensible platform from the secured position (restraining cable attached).

Coupler operation after tracking to the extreme right and left positions was performed without difficulty with the platform in a skewed position due to the interference previously described.

c. Problems Encountered

At the tracking position nearest the chamber opening interference was found between the coupler trigger linkage and the dock seal retaining bar at the bottom of the chamber opening and prevented coupling to the vehicle hardpoint. The trigger mechanism was modified by removing the linkage and operating the mechanism closer to the latch point. This modification permitted normal coupling operation and also provided adequate clearance with the dock seal retaining bar.

Operation of the coupler at each of the four points required additional force to compress the platform bumper as the vehicle hardpoint was engaged. This condition was not considered prohibitive or detrimental to actual operating conditions.

4. Test No. 4 - Dock Seal System Test

a. Test Objectives

(1) To ensure that each blower will satisfactorily inflate and extend the dock seal.

(2) To ensure that proper inflation and sealing can be maintained at extremes of motion envelope.

(3) To determine force applied to vehicle skin by dock seal during tracking.

(4) To determine loads induced into vehicle hardpoint by the arm coupler.

(5) To determine pressure (pound per square inch) exerted on dock seal contact area.

(6) To ensure that the dock seal will satisfactorily track without scrubbing the vehicle skin.

b. Test Results

Manual extension and retraction of the dock seal and supporting mechanism was performed inside the chamber by positioning the three support rods from minimum to maximum dimension. Moderate effort was required to move the support rods due to friction in the trunnion bearings and the resistance of the seal fabric to extend in length. This condition may become detrimental in field conditions due to moisture and dust contamination on the exterior surface of the support rods.

(1) Operation with either or both blowers resulted in the same degree of fabric stiffness and air pressure remained within 3.5 to 3.75" H_2O regardless of operating conditions. Shuttle valve operation did not affect the inflated condition of the dock seal due to the fast response time of the damper valve. It was noted that any manual force against the dock seal to reposition folds or the vehicle skin footprint resulted in audible operation of the damper valve. Leakage was checked at several fabric seams and found to be negligible.

De-energizing both dock seal blowers resulted in a pressure decay time of 15 seconds until the pressure indication read 0 inches H_2O. Seal behavior indicated a uniform reduction of pressure and fabric stiffness for the entire seal assembly.

(2) Dock seal contact with the vehicle skin panel was continuous on all sides and provided a contact area approximately 4-inches wide at center nominal position but varied considerably at the four tracking positions. During initial inflation of the dock seal, manual arrangement is required to eliminate major folds or fabric wrinkles in contact with the vehicle skin surface.

(3) Cumulative loads around the OWS access door location did not exceed 330 pounds compressive load and occured when tracking toward the chamber opening Point D. Load cell measurements #1 through #4 on Reference E indicate specific loads at the various tracking positions.

(4) The maximum loads at the vehicle hardpoint, (load cell #5 and #6) occured during tracking to the extreme right and left positions (Points F and B, Reference E) and resulted in a tension load of 305 pounds. Tracking motion from center nominal toward the chamber, Point D, resulted in a 5 pound compressive load and tracking away from the chamber, Point E, resulted in a tension load of 180 pounds.

(5) Vehicle skin pressure calculations are based on test conditions where the maximum load occured; tracking toward the chamber from center nominal position. Area calculations for a 4-inch contact area on both sides and the top of the foot-print is equivalent to 644 sq. inches and 256 sq. inches respectively. A contact area of 3 inches across the bottom for the applicable length is 192 sq. inches. Total contact area is 1092 sq. inches for a force of 330 pounds or a resultant pressure of .30 PSI.

(6) The modified dock seal was inflated with both blowers and the vehicle simulator was moved through the four points of the tracking envelope. An adequate seal was maintained on the vehicle skin panel when motion occured toward and away from the chamber opening (Points D and E). Tracking motion to either side of center nominal resulted in excessive folding and bulging of the dock seal fabric. Physical conditions that were observed are shown in References J, K, L, M, N and O.

c. Problems Encountered

(1) The initial attempt to inflate the dock seal with either or both blowers resulted in circuit breaker overload. The 15 amp breakers installed in the power distribution panel were rated for instantaneous service rather than the time delay type. One blower was removed, a bench test was performed and a starting current of 28 amps was measured. As an interim fix, 30 amp breakers were installed to permit continuation of the test.

(2) During tracking motion away from the chamber, the length of the dock seal was insufficient to maintain contact with the vehicle skin. Separation occured along both sides after 6 inches of travel from center nominal position. The dock seal was removed and modified to add two 6 inch convolutes or 12 additional inches in length. Data sheets (Reference E) reflect test results after the modified dock seal was re-installed and tested.

A small quantity of water was used to check the quality of the seal at the center nominal position and leakage occured through the top portion of the foot-print. Since the seal is not 100% effective, additional protection is required if access to the spacecraft is permitted during marginal weather conditions outside the VAB.

(3) The additional length of the dock seal resulted in large fabric bulges when tracking toward the chamber opening and reduced the volume of work space between the chamber opening and the vehicle skin. Tracking away from the chamber an adequate seal was maintained on the vehicle skin with no bulging or heavy folds of the dock seal.

Vehicle skin loads recorded under these conditions are shown on Reference E for load cells No. 1 through 4. Maximum loads on the vehicle skin with the platform coupled (loaded with 600 pounds) and the dock seal inflated occured at the tracking point toward the chamber and resulted in 330 pounds of force against the skin panel.

Data was also obtained for either blower and both blowers operating at the center nominal position only. Maximum cumulative load on the skin panel resulted in a compression load of 155 pounds.

(4) During the vehicle hardpoint load evaluation, considerable compression of the inside corner of the platform bumper was observed when tracking at the extreme right and left positions. The force was sufficient to produce a bending moment at the vehicle hardpoint and resulted in additional loads that were unacceptable. A modification was performed to remove approximately 1/2" of bumper material and add a teflon strip to the contact surface that would reduce any abrasive force with the vehicle skin. Data obtained reflect test results with the modified bumper.

(5) Calculation of pressure exerted on the dock seal contact area of the vehicle skin was determined only for the point where maximum skin load occured. The amount and location of fabric folds varied each time tracking movement occured and returned to a given position. The partial rolling and scrubbing of the dock seal fabric at the extreme right and left positions also introduced a variable condition as related to contact area.

(6) Tracking motion to the extreme right or left position with the dock seal inflated resulted in an unsatisfactory seal on the skin panel. During the last 6 inches of movement the end convolute forming the footprint began to roll on both sides of the vehicle skin and some scrubbing occured during the last 2 inches of movement.

5. Test No. 5 - Service Arm Assembly Weight and Center of Gravity Determination

a. Test Objective

To determine handling characteristics and requirements during transportation, installation or removal of the arm assembly.

b. Test Results

The complete arm assembly was lifted by two cranes simultaneously at the two extreme end lift positions. Both cranes were rigged with spring dynamometers between the crane hook and the lifting slings.

Calculation of center of gravity is as follows:

Total load at hinge end, L_H = 49000 pounds

Total load at chamber end, L_{CH} = 7200 pounds

Total length between left points = 49.6 feet

$$L_H (x) = L_{CH} (49.6 - x)$$

$$49000\,x = 7200\,(49.6 - x)$$

$$490\,x = 3571.2 - 72\,x$$

$$x = \frac{3571.2}{562}$$

= 6.358 feet, as measured from hinge lift point toward center of arm assembly.

All lifting equipment included in the above weighed 2000 pounds, therefore, the basic arm weight is 54200 pounds.

c. Problems Encountered

No problems were encountered during test operations to determine weight and C.G., however, subsequent problems were encountered during the service arm installation on the Mobile Launcher and relate to the C.G. location.

Installation of all fittings, spreader beams and lifting cables on the arm assembly was accomplished per drawing 75M12291, Revision E to transport the arm from the test area to High Bay No. 2. Interference was found with the 75M12290-3 lifting fitting and the weldments on both sides of the arm lifting eye located on the chamber end of the first element truss section. The lifting fittings (75M12290-3) were deleted from the configuration at this point only and the turnbuckle was connected directly to the arm.

During installation of the arm assembly on Mobile Launcher No. 2 the travel of the high bay crane was not sufficient to properly align the hinge assemblies to the ML structure. The final 17 inches of travel required to align the hinge bolt holes was obtained by using additional rigging and a ratchet action hand hoist.

SECTION V. CONCLUSIONS AND RECOMMENDATIONS

The evaluation of test results indicate that many of the problems encountered during test operations can be eliminated without major modifications by accomplishing the following.

1. Reduce the tracking envelope specification from the present 24 inches to 12 inches and subsequently:

A. Eliminate the mechanical interference of the Extensible Platform and the Chamber opening.

B. Reduce undesirable fabric behavior of the modified dock seal assembly.

C. Reduce vehicle skin loads due to a smaller platform displacement from the center nominal position.

D. Eliminate the requirement for the longer dock seal assembly.

2. Eliminate the trunnion assemblies and dock seal support rods since the inflated dock seal maintains its desired shape and tracking capability with inflation pressure only. Contamination of the support rod bearing surfaces will be detrimental to field operations and promote more resistance of the dock seal to maintain an adequate footprint while tracking vehicle motion.

3. Incorporate a semi-rigid non-absorbent sponge rubber collar around the dock seal footprint area to maintain the desired shape in an inflated or deflated condition and provide a more effective weather seal for moisture. The subject collar should have a funnel shaped cross section with a flexible tapered edge on the outside perimeter such that increasing dock seal pressure provides a more effective seal.

4. Reposition the center of gravity location on the arm assembly an additional 18 inches (minimum) toward the center of the arm structure with the placement of weights at the service arm tip. This change is urgently recommended if the SVWS Access Arm requires removal and reinstallation from the Mobile Launcher.

It is recommended that the acceptance of the Environmental Chamber for Skylab I operations be predicated on the incorporation of Items 1, 2 and 3 above.

REFERENCE "A"

COPY NO. _____
NAME _____

JOHN F. KENNEDY
SPACE CENTER

Bendix Launch Support Division

PROCEDURE NO: ATP-001

TITLE SVWS (SATURN V WORKSHOP) SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST, C-39, KSC

EFFECTIVITY: APR 7 1972

PERSONNEL PERFORMING THIS PROCEDURE SHALL REVIEW ALL CHANGES AGAINST THIS PROCEDURE, PRIOR TO THE START OF THE OPERATION. SUPERVISION SHALL ENSURE PERSONNEL USE AND FOLLOW THIS DOCUMENT.

THIS TOP CONTAINS HAZARDOUS OPERATIONS

PROCEDURE NO. ATP-001

REVISION BASIC

DATE

NO. OF PAGES 28

EFFECTIVITY APR 7 1972

TITLE

SVWS (SATURN V WORKSHOP) SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST, C-39, KSC

THIS TOP CONTAINS HAZARDOUS OPERATIONS

NASA

APPROVED BY [signature] DD-MDD-3, 3-29-72
NASA SYSTEM ENGINEER/DATE

APPROVED BY R.T. Gruber SO 3-24-72
NASA TECHNICAL REPRESENTATIVE/DATE

APPROVED BY R.T. Gruber, SO 3-24-72
NASA SYSTEM CONTROL/DATE

APPROVED BY [signature] 3/31/72
KSC SAFETY OFFICE/DATE

CONTRACTOR

PREPARED BY J E Vernier 3/24/72
ENGINEER/DATE

CONCURRENCE BY NA
OPERATING DEPARTMENT/DATE

APPROVED BY B R Bassett 3/24/72
MANAGER C&O/DATE

APPROVED BY [signature] 3/21/72
QUALITY

APPROVED BY R B Hudson 3/17/72
SAFETY/DATE

Bendix Launch Support Division

Contract NAS10-1600

Procedure No ATP-001

Date Issued

File Ref

SUBJECT SVWS (SATURN V WORKSHOP) SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST, C-39, KSC

SUPERSESSIONS

1.0 INTRODUCTION

1.1 PURPOSE

This document establishes compliance with design specifications after the fabrication and assembly of the SVWS side access arm 6A environmental chamber.

1.2 SCOPE

Procedure verifies that test criteria specified in document 79K00069 has been complied with and that the equipment satisfactorily performs its intended function and is structurally adequate.

1.3 DESCRIPTION AND LOCATION

1.3.1 Description

1.3.1.1 Equipment

The environmental chamber consists of a hard-shell enclosure with an internally mounted extensible platform, an inflatable bellows seal controlled by a blower system for weather protection, interior lighting, communications, and supporting equipment.

1.3.1.2 Specific Hazards

- Crane operations

1.3.2 Location - Procedure will be performed in temporarily assigned work area in the VAB Transfer Aisle, C-39, KSC.

Concurrence:

Date

Date

Approval:

Date

Date

1.4 DEFINITIONS

AC	Alternating current
CB	Circuit breaker
CG	Center of gravity
FEC	Federal Electric Corporation
FT	Foot (feet)
PCR	Procedure Change Request (form)
PN	Part number
PSIG	Pounds per square inch gage
LUT	Launch Umbilical Tower
SVWS	Saturn V Workshop
VAB	Vehicle Assembly Building

2.0 REFERENCES

2.1 OPERATIONAL

NOTE

The following documents, as referenced in Paragraph 8.0, must be utilized.

2.1.1 T9K00731, Mechanical Installation, SVWS Side Access Arm Environmental Chamber.

2.1.2 T9K01512, Test Fixture Set Up, SVWS Side Access Arm.

2.2 BACKGROUND

NOTE

Personnel must be familiar with the following documents.

2.2.1 Bendix/KSC Safety Manual, Section VII.

2.2.2 T9K00069, Test Criteria for SVWS Access Arm, Skylab 1.

2.2.3 T9K00729, Environmental Chamber Assembly, SVWS Side Access Arm.

2.2.4 79K01178, Test Fixture.

3.0 REQUIREMENTS

3.1 ESSENTIAL PERSONNEL

NOTE

Personnel requirements are the direct responsibility of supervision. Any additional personnel (for hazardous operations only) must be approved through the KSC Safety representative.

NOTE

Supervision will ensure that personnel are properly trained and qualified. Nonessential personnel shall be denied access to the area.

3.1.1 Project engineer (1).

3.1.2 Foreman (1).

3.1.3 Mechanics (2).

3.1.4 Electrician (1).

3.1.5 Quality Assurance personnel (1), optional.

3.2 EQUIPMENT AND MATERIALS

3.2.1 Equipment

3.2.1.1 Support frame assembly, 79K00721.

.2 Instrumentation equipment trailer, furnished by NASA IN (FEC), to provide direct readout of load cell output.

.3 Test weights (48), 50 pounds each.

.4 Dial indicator (1), 0- to 2-inch span capable of readout to 0.01 inch.

3.2.1.5 Spring dynamometers (2), 0- to 25-ton capacity or equivalent with associated attaching hardware.

.6 Lifting equipment service arm, 75M12291, and associated attaching hardware.

.7 Lifting frame assembly, 79K00723.

.8 Tracking targets: Target positions and 24-inch circle painted on 4-FT by 8-FT by 3/4-inch plywood sheet (Figure 1).

.9 Forklift, with modified lift system, PN 79K01721-1.

.10 Crane, overhead, 10-ton minimum lift capacity.

.11 Measuring tape, steel, 100-FT.

.12 See Paragraph 4.1.1 for safety equipment (personal).

3.2.2 Materials

3.2.2.1 Sheet, plastic.

3.2.2.2 Tape, pressure-sensitive, adhesive.

3.3 SPECIAL INSTRUMENTATION MEASUREMENTS

3.3.1 TOROID load cells (six) located on test fixture to measure imposed loads on simulated S-IVB vehicle skin.

3.3.2 Instrumentation equipment trailer containing signal conditioning and strip chart recorders.

3.4 SPECIAL COMMUNICATION AIDS

None required.

3.5 SPECIAL AUTHORIZATION

Performance of this procedure shall be authorized by released modification documentation.

4.0 SPECIAL INSTRUCTIONS

Performance of this acceptance test may require real-time changes to the test sequence due to data observed. These changes will be authorized by an on-site NASA DE representative, except for hazardous operations.

4.1 SAFETY

4.1.1 Safety Equipment (Personal) - Hardhats (required for overhead crane operations).

4.1.2 Safety Monitoring - Supervision has a basic responsibility for the safety of personnel and equipment and shall ensure operations are performed safely according to approved procedures.

4.1.3 Deviations - Deviations from this procedure shall normally be accomplished by PCR. Any deviation which increases the hazard level or alters any safety requirement must be approved by Bendix Industrial Safety and KSC Safety before use.

4.2 RELIABILITY AND QUALITY ASSURANCE REQUIREMENTS

Report deficiencies, exceptions, and failures according to procedures governing the DR/IPD system.

4.3 CHANGES AND REVISIONS

Changes and revisions to this procedure shall be accomplished by red-line changes approved by signature from the on-site NASA DE representative.

5.0 PREPARATIONS

5.1 Notify Quality Assurance before starting procedure.

5.2 Personnel performing procedure shall ensure system and components cleanliness is maintained during the performance of this procedure, and any work performed is according to normal shop practice, and systems specifications.

5.3 Check all lifting equipment and verify all required items have in-date proof load tags.

6.0 PROCEDURE

NOTE

Refer to Figures 1 through 4 for equipment illustrations, layouts, and schematics.

6.1 EMERGENCY PROCEDURE

In case of crane malfunction, stop operation and take action as directed by supervision.

6.2 SVWS CHAMBER LOAD AND PROOF TEST

Perform Appendix 8.1

6.3 EXTENSIBLE PLATFORM AND TRACKING TEST

Perform Appendix 8.2.

6.4 PLATFORM COUPLER ACTUATION TEST

Perform Appendix 8.3.

6.5 DOCK SEAL SYSTEM TEST

Perform Appendix 8.4.

H 6.6 SERVICE ARM ASSEMBLY WEIGHT AND CG DETERMINATION

Perform Appendix 8.5

7.0 POST PROCEDURE

Verify all test data, modifications, if performed, and general configuration of the environmental chamber have been accepted by the NASA DE organizations. Secure all test equipment to prepare service arm assembly for installation on the LUT.

Make changes as Redlined. J. V. Cook 6/21/72 DO-MOO-31

8.0 APPENDICES

8.1 SVWS CHAMBER LOAD AND PROOF TEST

8.1.1 Checkout.

8.2 EXTENSIBLE PLATFORM AND TRACKING TEST

8.2.1 Checksheet.

8.3 PLATFORM COUPLER ACTUATION TEST

8.3.1 Checksheet.

8.4 DOCK SEAL SYSTEM TEST

8.4.1 Checksheet.

8.5 SERVICE ARM ASSEMBLY WEIGHT AND CG DETERMINATION

8.5.1 Checksheet.

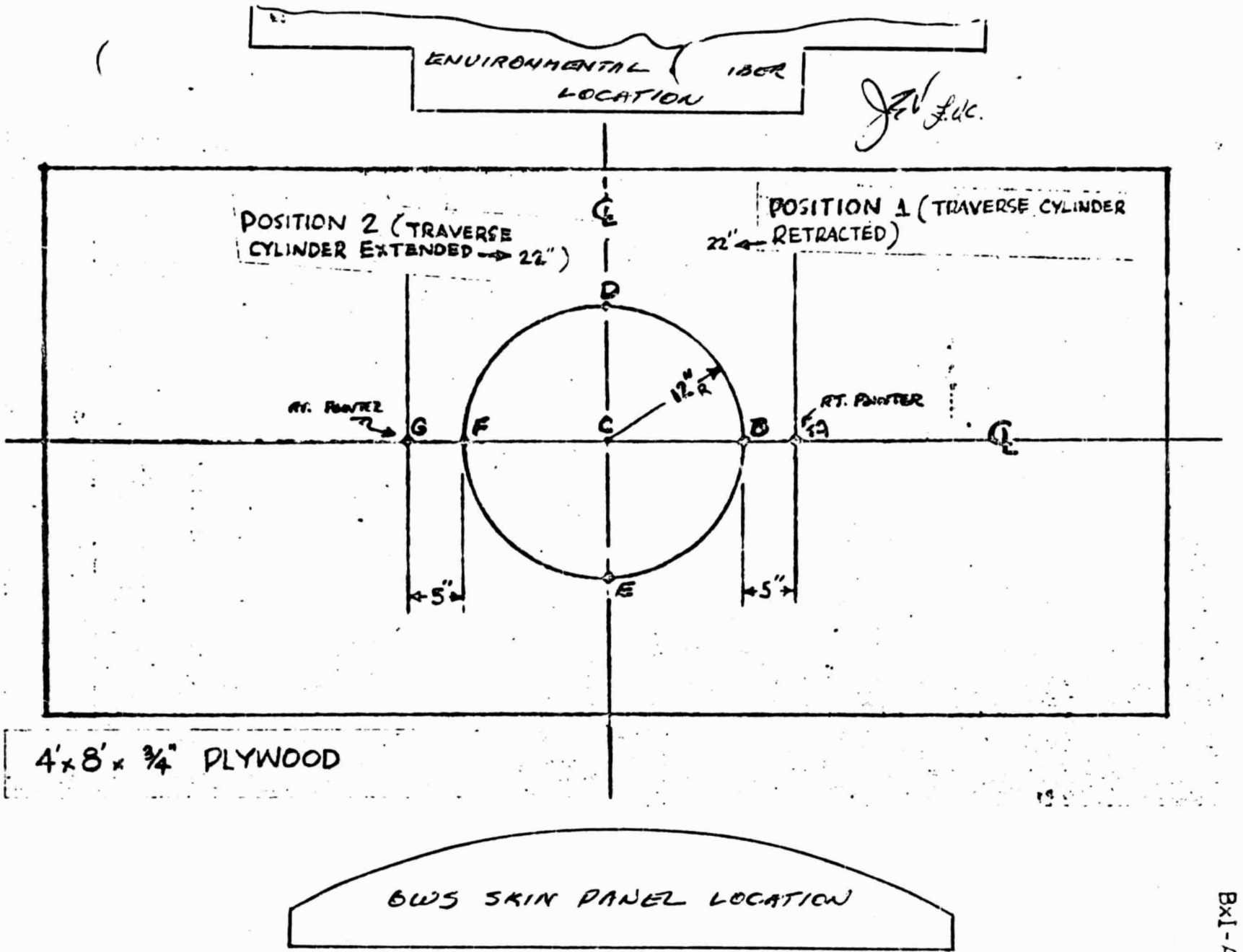


FIGURE 1
TRACKING TARGET

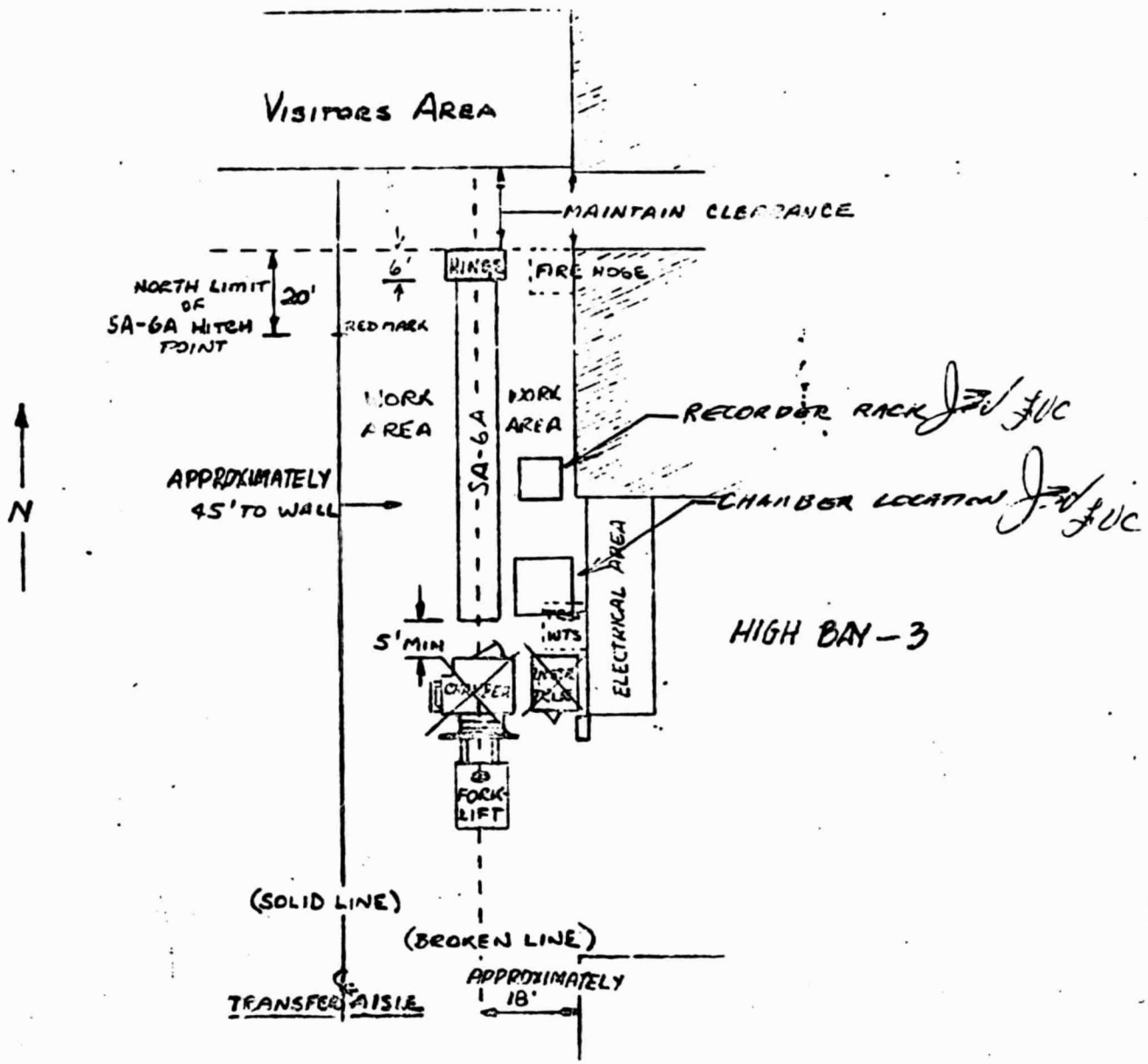


FIGURE 2

TEST AREA LAYOUT - VAB

BxI-ATP-2

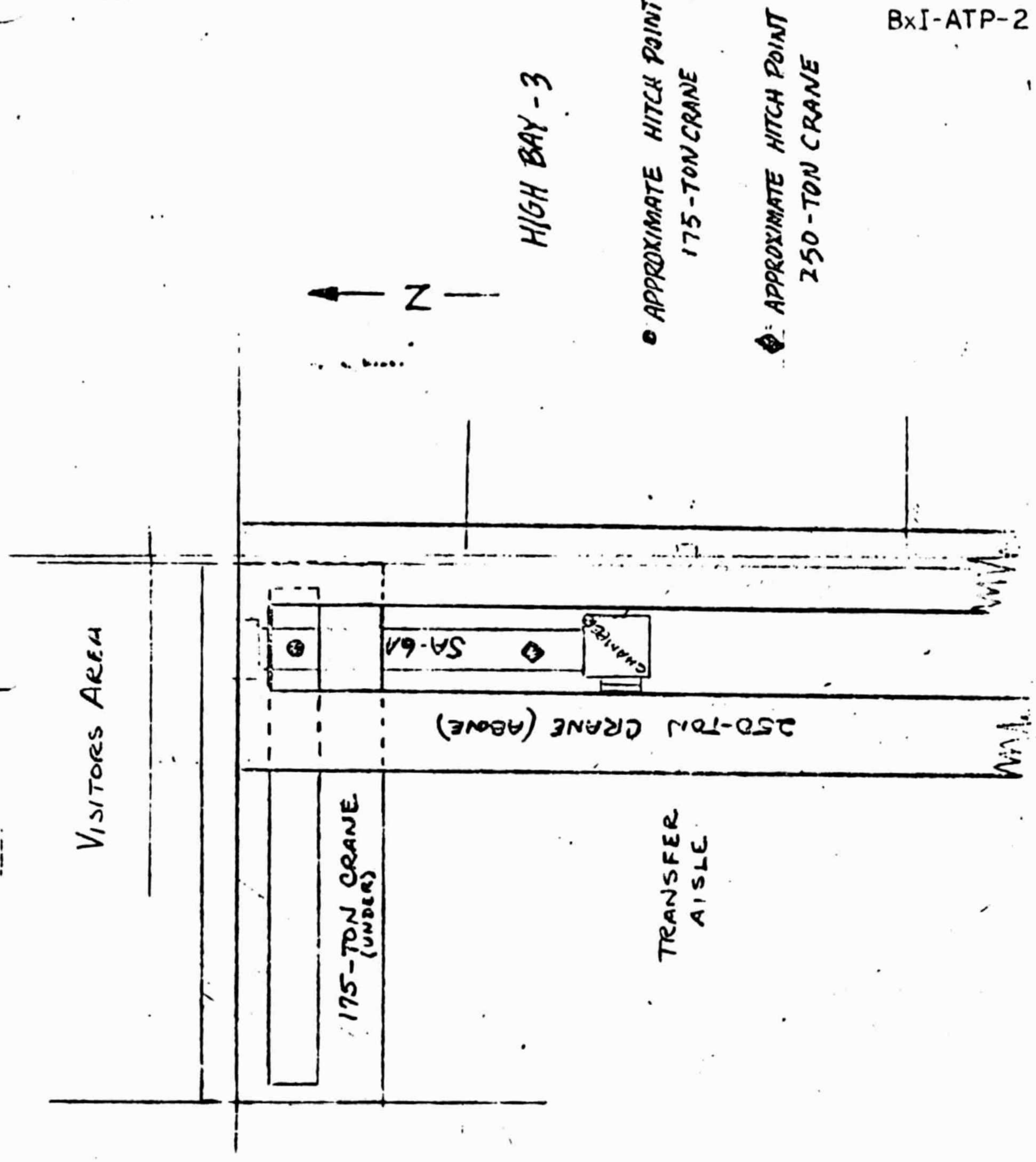


FIGURE 3

175- AND 250-TON CRANE ARRANGEMENT SERVICE ARM WEIGHT AND CG

3

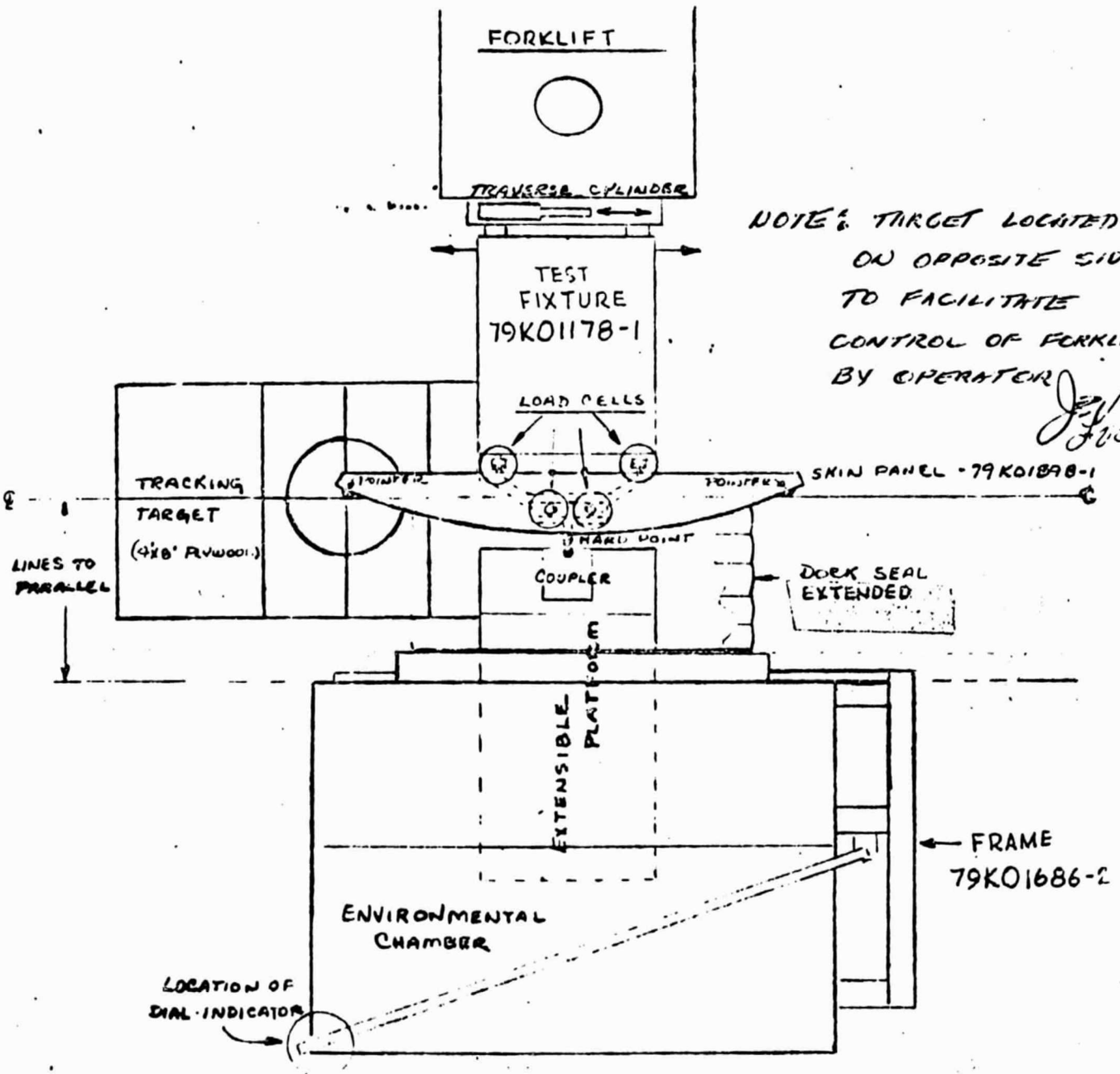


FIGURE 4
TEST EQUIPMENT ARRANGEMENT

8.1 SVWS CHAMBER LOAD AND PROOF TEST

8.1.1 Verify 48 test weights, 50 pounds each, are available at test site.

8.1.2 Verify chamber floor is covered with 3/4-inch plywood.

8.1.3 Ensure fastener bolts on transport frame and deflection beam are secure and tightened, and jack assemblies 79K00721-37 are set at STANDBY position.

8.1.4 Verify dial indicator (0- to 2-inch), clamps, and brackets are available for installation.

8.1.5 Verify dial indicator is located according to Drawing 79K01512 and set at 0 reading. INSTALL 2ND DIAL INDICATOR AT BOTTOM CORNER OF CHAMBER, BELOW THE TOP MEASURING POINT

8.1.6 Load 1,200 pounds of 50-pound weights, distributed uniformly over entire chamber floor.

8.1.7 Observe and record on checksheet deflection indicated by dial indicator reading (~~0.04"~~ 0.4" maximum deflection allowed)

WARNING

If, at any time during this test, the deflection reading exceeds ~~0.04"~~ 0.4", loading shall cease and NASA DE representative shall be consulted before proceeding.

8.1.8 Make visual check of chamber structures and fastenings, noting any distortions, movements, or yields.

8.1.9 Load additional 750 pounds of 50-pound weights, distributed uniformly over entire chamber floor.

8.1.10 Observe and record on checksheet deflection indicated by dial indicator reading.

8.1.11 Make visual check of chamber structure and fastenings, noting any distortions, movements, or yields.

8.1.12 Load additional 450 pounds of 50-pound weights, providing 2,400-pound total load distributed uniformly over entire chamber floor.

8.1.13 Observe and record on checksheet deflection indicated by dial indicator reading.

8.1.14 Make visual check of chamber structure and fastenings, noting any distortions, movements, or yields.

8.1.15 Remove 450-pound load from chamber; stack on pallet.

8.1.16 Observe and record on checksheet dial indicator reading, noting recovery and any permanent distortions.

8.1.17 Remove 750-pound load from chamber; stack on pallet.

8.1.18 Observe and record on checksheet dial indicator reading, noting recovery and any permanent distortions.

8.1.18.1 REMOVE 600 LBS OF WEIGHT, CHECK DIAL INDICATOR READING WITH REMAINING 600 LB LOAD

8.1.19 Remove remaining 1,200-pound load from chamber; stack on pallet and secure with chain and lock.

LOCK'D

8.1.20 Observe and record on checksheet dial indicator reading, noting recovery and any permanent distortions.

CHECK SHEET	APPENDIX 8.1.1	PAGE 1 OF 1
EQUIPMENT/SYSTEM NAME: SVWS SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST	EQUIP./SYS. NO.	FILE REF.
LAUNCHING FACILITY NAME: C-39, KSC	BLDG./FAC. NO.: K6-848	PROCEDURE NO.: PCR ATP-001
DATE SCHEDULED	TECHNICIAN'S SIGNATURE	LEGEND: √ SATISFACTORY; X UNSATISFACTORY
DATE COMPLETED: 4/3/72	SUPERVISOR'S SIGNATURE	

PAR. NO.	CHECK ITEM	LEGEND
8.1	SVWS CHAMBER LOAD AND PROOF TEST	////////////////////
8.1.1	Verified.	
8.1.2	Verified.	
8.1.3	Ensured.	
8.1.4	Verified.	
8.1.5	Verified. (3RD DIAL INDICATOR INSTALLED DUE TO EXCESSIVE VIBRATION OF TOP MEAS. POINT.)	√ 4-3-72
8.1.6	Performed.	
.7	600 POUND DEFLECTION: TOP POINT .0035; BOTTOM POINT .033 1,200-pound deflection: .0075 ". .050 "	
8.1.8	Performed.	
8.1.9	Performed.	
8.1.10	1,950-pound deflection: .0130 ". .091"	4-3-72
8.1.11	Performed. NO DEFORMATION OR FAILURE OBSERVED	
8.1.12	Performed.	4-3-72
8.1.13	2,400-pound deflection: .0170 ". .100	(HELD FOR 5 MIN.)
8.1.14	Performed.	
8.1.15	Performed.	4-3-72
8.1.16	1,950-pound deflection: .0125 ". .082 "	
8.1.17	Performed.	
8.1.18	1,200-pound deflection: .008 ". .053	4-3-72
19	600 POUND DEFLECTION: .004 .026 Performed.	
8.1.20	0-load deflection: −.0005 ". .0025	4-3-72

8.2 EXTENSIBLE PLATFORM AND TRACKING TEST

8.2.1 ~~Extend extensible platform assembly 79K00748-1 and connect to hard point on test fixture.~~ DELETE, NOT REQUIRED FOR ALIGNMENT Align coupler hard point in horizontal and vertical neutral to target center positioned on floor.

8.2.2 Verify chamber dock seal is in the retracted position.

8.2.3 Load 50-pound weights to provide a uniformly distributed load of 600 pounds on extensible platform and observe structure for deformation.

8.2.4 Add an additional 350 pounds of weight uniformly distributed on extensible platform and observe structure for deformation.

8.2.5 Add an additional load of 250 pounds to provide a total uniformly distributed load of 1,200 pounds on extensible platform. Observe structure for deformation.

8.2.6 Manually move platform to each of the four points on the 24-inch-diameter circle and verify no mechanical interference with platform components.

NOTE

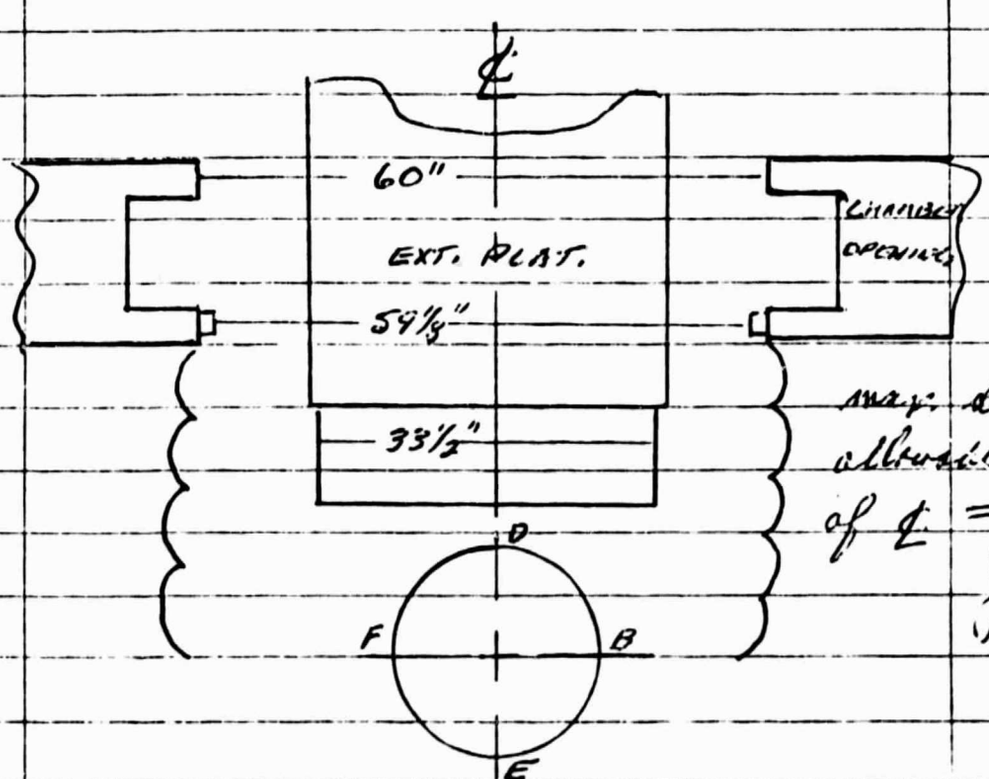
Tracking of the platform can be facilitated by temporarily clamping a reference pointer to the coupler to align the various target positions.

8.2.7 Upon satisfactory completion of tracking operations, remove weights uniformly from extensible platform surface.

8.2.8 Visually check all platform components for deformation, all rubbing surfaces for abrasion, and all bearings for freedom of operation. Disassembly for inspection is not required unless a fault is suspected.

CHECK SHEET APPENDIX 8.2.1		PAGE 1 OF 1
EQUIPMENT SYSTEM NAME SVWS SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST	EQUIP. SYS. NO.	TILE REF.
BUILDING FACILITY NAME B-39, KSC	BLDG./FAC. NO. K6-848	PROCEDURE NO PCR ATP-001
DATE SCHEDULED	TECHNICIAN'S SIGNATURE	LEGEND √ SATISFACTORY X UNSATISFACTORY
DATE COMPLETED 4/4/72	SUPERVISOR'S SIGNATURE	

PAR. NO.	CHECK ITEM	LEGEND
8.2	EXTENSIBLE PLATFORM AND TRACKING TEST	//////////////////
8.2.1	Performed.	
8.2.2	Verified.	
8.2.3	Performed.	
8.2.4	Performed.	
8.2.5	Performed.	
* 8.2.6	Performed { INTERFERENCE NOTED AT POINTS "F" AND "B" WITH EXT. PLAT AND CHAMBER OPENING, ALSO AT POINT "E" WITH PLAT. SUPP. RODS AND TOP OF CHAMBER OPENING.	
.7	Performed.	
8.2.8	Performed.	



max. displacement allowable to either side of ℄ = 11.75"

8.3 PLATFORM COUPLER ACTUATION TEST (FIGURE 1)

8.3.1 Verify one man is on extensible platform to operate coupler for platform coupler actuation test.

8.3.2 Position forklift with traverse cylinder retracted and with test fixture pointer in extreme right-hand position at position A.

8.3.3 Position test fixture hard point on same plane and centerline with extensible platform.

8.3.4 Position test fixture with right pointer on position A.

8.3.5 Move test fixture pointer to position C.

8.3.6 Couple extensible platform to hard point.

8.3.7 Move test fixture pointer to position D. Restrain platform from sudden end motion. Release coupler from hard point. Record any discrepancies on checksheet.

8.3.8 Operate coupler. Record any discrepancies on checksheet.

8.3.9 Recouple to hard point in position D. Record any discrepancies on checksheet.

8.3.10 Return pointer to position C.

8.3.11 Move test fixture pointer to position E. Restrain platform from sudden end motion. Release coupler from hard point. Record any discrepancies on checksheet.

8.3.12 Operate coupler. Record any discrepancies on checksheet.

8.3.13 Recouple to hard point in position E. Record any discrepancies on checksheet.

8.3.14 Return pointer to position C.

8.3.15 Move test fixture pointer to position B. Restrain platform from sudden side motion. Release coupler from hard point. Record any discrepancies on checksheet.

8.3.16 Operate coupler. Record any discrepancies on checksheet.

8.3.17 Recouple to hard point in position B. Record any discrepancies on checksheet.

8.3.18 Return pointer to position C.

8.3.19 Uncouple extensible platform from hard point.

8.3.20 Position forklift with test fixture pointer in extreme left-hand position (traverse piston completely extended).

8.3.21 Position test fixture with the pointer on position G.

8.3.22 Move test fixture pointer to position C.

8.3.23 Couple extensible platform to hard point.

8.3.24 Move test fixture pointer to position F. Restrain platform from sudden side motion. Release coupler from hard point. Record any discrepancies on checksheet.

8.3.25 Operate coupler. Record any discrepancies on checksheet.

8.3.26 Recouple to hard point in position F. Record any discrepancies on checksheet.

8.3.27 Return pointer to position C.

8.3.28 Release coupler from hard point. Record any discrepancies on checksheet.

CHECK SHEET	APPENDIX 8.3.1	PAGE 1 OF 2
EQUIPMENT SYSTEM NAME CCTV'S SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST	EQUIP. SYS. NO.	FILE REF.
BUILDING FACILITY NAME C-39, KSC	BLDG./FAC. NO. K6-848	PROCEDURE NO. PCR ATP-001
DATE SCHEDULED	TECHNICIAN'S SIGNATURE	LEGEND √ SATISFACTORY X UNSATISFACTORY
DATE COMPLETED 4/4/72	SUPERVISOR'S SIGNATURE	

PAR. NO.	CHECK ITEM	LEGEND
8.3	PLATFORM COUPLER ACTUATION TEST	//////////////////
8.3.1	Verified.	
8.3.2	Performed.	
8.3.3	Performed.	
8.3.4	Performed.	
8.3.5	Performed.	
.6	Performed.	
8.3.7	Performed.	
8.3.8	Performed.	
8.3.9	Performed. INTERFERENCE FOUND WITH COUPLER TRIGGER LINKAGE AND SEAL RETAINING BAR AT BOTTOM OF CHAMBER OPENING. REMOVED LINKAGE MODIFIED TRIGGER RELEASE AND ELIMINATED INTERFERENCE. JFC	
8.3.10	Performed.	
8.3.11	Performed. INTERFERENCE FOUND WITH EXT. PLAT. FRONT SUPPORT RODS AND TOP OF CHAMBER OPENING AT POINT "E". PLAT HEIGHT ABOVE FLOOR NOT SPECIFIED ON DWG. RESET FROM 3.8" TO 2.0" TO ELIMINATE INTERFERENCE JFC	
8.3.12	Performed.	
8.3.13	Performed.	
8.3.14	Performed.	
8.3.15	Performed.	
8.3.16	Performed.	
8.3.17	Performed.	
8.3.18	Performed.	
.19	Performed.	
8.3.20	Performed.	

CHECK SHEET (Continued) ATP-001 APPENDIX 8.3.1		PAGE 2 OF 2
PAR. NO.	CHECK ITEM	LEGEND
8. 1	Performed.	
8.3.22	Performed.	
8.3.23	Performed.	
8.3.24	Performed.	
8.3.25	Performed.	
8.3.26	Performed.	

* 1ST ATTEMPT, STARTED 4/5, TERMINATED TEST 4/6, SEE NOTE PAGE 3 BACK

*	8.4	DOCK SEAL SYSTEM TEST
	8.4.1	Verify extensible platform has been checked satisfactorily according to Appendix 8.2.
	8.4.2	Verify coupler operation has been checked satisfactorily according to Appendix 8.3.
	8.4.3	Verify no load on extensible platform and bellows are not inflated.
	8.4.3.1 JSC	VERIFY ALL BELLOWS SEAL SECURING STRAPS ARE DISCONNECTED PRIOR TO INFLATING.
	8.4.4 JSC	Verify load cells installed on test fixture and connected to instrumentation van. Obtain a strip chart recording and identify each channel.
	8.4.4.1 JSC	VERIFY VEHICLE SKIN PANEL IS PARALLEL TO VERTICAL FWD OF CHAMBER BY VISUAL CHECK.
	8.4.5 JSC	Manually extend and retract dock seal and support rods to their maximum/minimum dimensions (reference 79K00731, sheet 2).
	8.4.6	Verify extension and retraction is smooth with no binding of support hardware or interference between dock seal and extensible platform or coupler.
	8.4.7	Verify AC power test cable for blower 1 connected to J-1 on Power Distribution Assembly.
	8.4.8	Verify AC power test cable for blower 2 connected to J-6 on Power Distribution Assembly.
	8.4.9	Verify power cables are properly connected at Power Distribution Assembly in environmental chamber and to AC breakout box.
	8.4.10	Position test fixture hard point into platform coupler with platform in a neutral unloaded position.
	8.4.11	With coupler not engaged, verify no loads imposed on extensible platform coupler.
*	8.4.12	Place CB 1 to the ON position on the Power Distribution Assembly in environmental chamber and observe that blower 1 operates.
	8.4.12.1	Verify dock seal inflates and a seal is maintained. Obtain a strip chart recording.

8.4.12.2 Record on checksheet pressure from environmental chamber pressure gage on left side of chamber (facing test fixture).

.3 Observe shape and contour of dock seal to vehicle contact area and check seam integrity.

.4 Place CB 1 to the OFF position and record on checksheet pressure decay time to atmospheric pressure.

8.4.13 Place CB 2 to the ON position on the Power Distribution Assembly in environmental chamber and observe that blower 2 operates.

8.4.13.1 Verify dock seal inflates and a seal is maintained. Obtain a strip chart recording.

.2 Record on checksheet pressure from environmental chamber pressure gage on left side of chamber.

.3 Observe shape and contour of dock seal to vehicle contact area and check seam integrity.

.4 Place CB 2 to the OFF position and record on checksheet pressure decay time to atmospheric pressure.

8.4.14 Place CB 1 and CB 2 to the ON position and observe that both blowers operate.

8.4.14.1 Verify dock seal inflates and a seal is maintained. Obtain a strip chart recording.

.2 Record on checksheet pressure from environmental chamber pressure gage on left side of chamber.

.3 Observe shape and contour of dock seal to vehicle contact area and check seam integrity.

.4 Shift position of shuttle valve (manually) and observe dock seal inflation behavior.

.5 Record on checksheet pressure drop from seal inflation gage while shuttle is at extreme left and extreme right positions.

4.15 Deflate dock seal and align vehicle skin pointer at position A (Figure 1) with forklift traverse cylinder retracted.

8.4.16 Verify vehicle skin plane is coincident with horizontal centerline of target (positions G, F, C, B, and A, Figure 1).

8.4.17 Engage coupler to test fixture hard point.

8.4.18 Operate strip chart recorders and identify measurements.

8.4.19 Place a uniformly distributed load of 600 pounds on extensible platform (12 weights, 50 pounds each).

8.4.20 Operate strip chart recorders and identify measurements.

8.4.21 Move test fixture from center nominal (position C) to positions E, B, and D (Figure 1). Operate strip chart recorders during travel and identify motion envelope positions on chart.

8.4.22 Realign forklift position with vehicle skin pointer at position G (Figure 1) (traverse cylinder fully extended).

8.4.23 Verify vehicle skin plane is coincident with the horizontal centerline of target (positions G, F, C, B, and A, Figure 1).

8.4.24 Move test fixture from center nominal (position C) to positions E, F, and D (Figure 1). Operate strip chart recorders during travel and identify motion envelope positions on chart.

8.4.25 Disconnect extensible platform coupler from test fixture hard point.

TURN BOTH BLOWERS "ON" AND

* 8.4.26 Move test fixture in a 24-inch-diameter circle through positions E, B, D, and F (Figure 1) and verify dock seal will track without "scrubbing" vehicle skin. Record on checksheet load measurements through all four positions.

8.4.27 Place CB 1 and CB 2 to the OFF position and record on checksheet pressure decay time to atmospheric pressure. Observe seal behavior during pressure decay.

K ITEM 8.4.12: First attempt to energize either blower resulted in circuit breaker overload (rated for 15 amps. instantaneous) Bench check of blower indicated 28 amps starting load. Installed 30 amp breaker to operate blowers for bellows seal functional test. This installation was on interim fix only to continue test. DE investigating corrective action which is to be documented as a design change. J. Vieira

REF ITEM 8.4.3.6: Tracking envelope of 24 inches resulting in bellows seal scrubbing vehicle skin after first 3 inches of motion in line parallel to face of chamber. Utilized 1 blower and 2 blower operation with no change in stiffness of bellows or tracking capability. Tracking on path toward or away from chamber, found seal separation when moving approx. 6 inches away from neutral point (away from chamber toward point "E". Bellows seal was removed and modified to incorporate 2 additional 6" convolutes extending overall length an additional 12 inches. J. Vieira

REF ITEM 8.4: Resumed test operations after installation of modified bellows seal and coupler assembly. (April 17, 1973) Appendix 8.1, 8.2 and 8.3 do not require rerun, data is satisfactory. Retest of 8.4 is required. Data obtained indicated max load of 430# which is 70# above max. allowable. Investigated load cell installation at handpoint and found that actual dimensions were not specified on Dwg 74K01512, SHT. 2, detail D. Revise vehicle handpoint to project additional 1/8" from vehicle skin and modified fit. plate bumper by removing approx 1/2" of rubber surface. J. Vieira

CHECK SHEET	APPENDIX 8.4.1	PAGE 1 OF 2
EQUIPMENT SYSTEM NAME SVWS SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST	EQUIP. SYS. NO.	FILE REF.
BLDG. FACILITY NAME C-39, KSC	BLDG. FAC. NO. K6-848	PROCEDURE NO. PCR ____ ATP-001
DATE SCHEDULED	TECHNICIAN'S SIGNATURE	LEGEND √ SATISFACTORY X UNSATISFACTORY
DATE COMPLETED 4/24/72	SUPERVISOR'S SIGNATURE	

PAR. NO.	CHECK ITEM	LEGEND
8.4	DOCK SEAL SYSTEM TEST	//////////////////
8.4.1	Verified.	
8.4.2	Verified.	
8.4.3	Verified.	
~~8.4.3.1~~	VERIFIED	
8.4.4	Verified/performed.	
~~8.4.4.1~~	VERIFIED	
8.4.5	Performed.	
4.6	Verified. {LAST LOOP ON BELLOWS SUPPORT RODS CAN SLIP OFF BEVELED END AND RESTRAIN BELLOWS AFTER BLOWERS ARE TURNED ON. JSV	
8.4.7	Verified.	6/25/72
8.4.8	Verified.	
8.4.9	Verified.	
8.4.10	Performed.	
8.4.11	Verified.	
8.4.12	Performed.	
8.4.12.1	Verified/performed. (see attached data sheet for load measurements)	
.2	Pressure: 3.5" H_2O ~~PSIG~~.	6/28/72
.3	Performed.	
.4	Performed; decay time: 11.0 seconds.	6/28/72
8.4.13	Performed.	
8.4.13.1	Verified/performed. (see data sheet)	6/28/72
.2	Pressure: 3.75" H_2O ~~PSIG~~.	
.3	Performed.	

PAR. NO.	CHECK ITEM	LEGEND
8.[illegible].4	Performed; decay time: 14.0 seconds.	
8.4.14	Performed.	6/28/72
8.4.14.1	Verified/performed. (see data sheet)	O'Toole O'Toole
.2	Pressure: 3.5 "H_2O ~~PSIG~~.	6/28/72
.3	Performed.	
.4	Performed.	O'Toole
.5	Pressure drop: Left 3.25 "H_2O ~~PSIG~~, Right 3.25 "H_2O ~~PSIG~~. PRESSURE DECAY TIME 15 SECS	" 6/28/72
8.4.15	Performed.	
8.4.16	Verified.	
8.4.17	Performed.	
8.4.18	Performed.	
8.4.19	Performed.	
8.4.[illegible]	Performed.	
8.4.[illegible]	Performed. (see data sheet)	
8.4.22	Performed.	
8.4.23	Verified.	
8.4.24	Performed. (see data sheet)	
8.4.25	Performed.	
8.4.26	Load measurements: Position E (see data sheet)	
	Position B	
	Position D	
	Position F	O'Toole
8.4.27	Performed; pressure decay time: 15 seconds.	6/28/72

8.5 SERVICE ARM ASSEMBLY WEIGHT AND CG DETERMINATION

8.5.1 Verify the following required equipment is available for test.

8.5.1.1 Overhead cranes, 175-ton and 250-ton.

.2 Spring dynamometers (2), 0- to 25-ton capacity or equivalent.

.3 Miscellaneous lifting gear, slings, and shackles.

.4 Measuring tape, steel, 100-FT.

8.5.2 Verify mating of environmental chamber has been completed and all loose equipment has been removed.

8.5.3 Attach one dynamometer to 25-ton hook on 175-ton crane, with required lifting gear.

8.5.4 Locate hook over lifting lugs nearest to hinge end of service arm. Attach lifting gear to arm lifting lugs. Verify hook is located over lift according to crane arrangement shown in Figure 3.

8.5.5 Attach one dynamometer to 25-ton hook on 250-ton crane, with required lifting gear.

8.5.6 Locate hook over lifting lugs nearest to environmental chamber on service arm. Attach lifting gear to lifting lugs. Verify hook is located over lift according to crane arrangement shown in Figure 3.

H 8.5.7 Lift service arm clear of support stands at each end. Record dynamometer readings on checksheet. Lower service arm onto support stands.

8.5.8 Remove dynamometer and lifting gear from 250-ton crane. Release crane.

8.5.9 Remove dynamometer and lifting gear from 175-ton crane. Release crane.

8.5.10 Determine overall length of SA-6A including hinges and environmental chamber. Record dimension on checksheet.

8.5.11 Determine overall distance from hinge end of service arm to centerline of nearest lifting point. Record dimension on checksheet.

8.5.12 Determine overall distance from chamber end of service arm to centerline of nearest lifting point. Record dimension on checksheet.

8.5.13 Compute location of CG with respect to lifting points specified in Paragraphs 8.5.11 and 8.5.12.

CHECK SHEET	APPENDIX 8.5.1	PAGE 1 OF 1
EQUIPMENT SYSTEM NAME SVWS SIDE ACCESS ARM 6A ENVIRONMENTAL CHAMBER ACCEPTANCE TEST	EQUIP./SYS. NO.	FILE REF.
BUILDING FACILITY NAME C-39, KSC	BLDG./FAC. NO. K6-848	PROCEDURE NO. PCR ATP-001
DATE SCHEDULED	TECHNICIAN'S SIGNATURE	LEGEND √ SATISFACTORY X UNSATISFACTORY
DATE COMPLETED 5/5/72	SUPERVISOR'S SIGNATURE	

PAR. NO.	CHECK ITEM	LEGEND
8.5	SERVICE ARM ASSEMBLY WEIGHT AND CG TEST	//////////////////
8.5.1	Verified.	
8.5.1.1	Verified.	
.2	Verified.	
.3	Verified.	
.4	Verified.	
8.5.2	Verified. (Completed installation April 26, 1972)	323 5/5/72 √
8.5.3	Performed.	
8.5.4	Performed/verified.	
8.5.5	Performed.	
8.5.6	Performed/verified.	
8.5.7	Performed; dynamometer readings: Hinge end 49000 LBS	
	Chamber end 7200 LBS.	
8.5.8	Performed.	
8.5.9	Performed.	
8.5.10	Performed; overall dimension: 70 FT. 7 1/16 IN.	
8.5.11	Performed; hinge end dimension: 7 FT. 6 1/2 IN.	
8.5.12	Performed; chamber end dimension: 13 FT 6 IN.	
8.5.13	CG: 76.9 inch(es) from hinge end lift point.	6/21/72
	CG: 518.4 inch(es) from chamber end lift point.	6/21/72

APPLICATION		PART NO.	NF
NEXT ASSY	USED ON		

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TEST CRITERIA

FOR

SVWS ACCESS ARM

SKYLAB I

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	ORIGINAL DATE OF DRAWING 23 FEB 71 DRAFTSMAN [illegible] BOWLES TRACER / CHECKER ENGINEER / ENGINEER SUBMITTED	TEST CRITERIA FOR SVWS ACCESS ARM SKYLAB I	JOHN F. KENNEDY SPACE CENTER, NASA KENNEDY SPACE CENTER FLORIDA
MATERIAL			
HEAT TREATMENT			
FINAL PROTECTIVE FINISH	APPROVED [signature]	SCALE / UNIT WT	DWG SIZE A — 79K00069 — SHEET 1 OF 14

CONTINUATION SHEET

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NSC FORM 21 (REV 7/61)

NASA-MSC OCT 72

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I. INTRODUCTION

The criteria developed herein are intended to be used in the preparation of test plans and procedures which will be sufficient to establish the reliability and conformity to design. The criteria consists of a description of the tests, pre-test requirements, instruments required, and the desired results. The sequence of tests is inherent within this document beginning with the major sectional breakdown. The philosophy employed in preparing these criteria is to limit the testing to that considered necessary to confirm that the equipment satisfactorily performs its intended function and is structurally adequate. The test criteria is concerned mainly with the functional testing of major systems such as the extend/retract system, extension platform, and chamber.

The weight and center of gravity of the arm and chamber should be recorded prior to arm installation.

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II. ENVIRONMENTAL CHAMBER

The purpose of the environmental chamber is to provide access to the workshop through an environmentally controlled atmosphere. The system for regulating the pressure of this conditioned air will be tested. The dock seal and extensible platform will be tested for vehicle motion tracking. Live load proof test of the chamber and extensible platform will be performed.

NOTE

Test contained in paragraphs A, B, C and D of this section shall be conducted prior to access arm installation with the environmental chamber assembled to the ground handling fixture. Test shall be discontinued and DD-MDD consulted for direction if any deviation from these criteria is observed.

A. Live Load Proof Test

This test is conducted to ensure that the chamber will satisfactorily support a simulated live load twice its rated live load.

1. Detailed Description of Test

   a. Simulate a uniformly distributed live load of 2400 pounds on the floor of chamber in the following manner: Load incrementally and uniformly observing chamber deflection after each load application. Maximum deflection shall not exceed 0.4 inches.

NOTE

If maximum allowable deflection is reached before total test load application, testing shall be discontinued and DD-MDD consulted for direction.

   b. Remove load incrementally and uniformly observing for any permanent deformation.

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2. Desired Results

   a. To determine that the chamber will support a load twice its rated live load of 1200 pounds with no permanent deformation.

B. Extensible Platform

This test is conducted to ensure that the extensible platform assembly will satisfactorily track the vehicle and support a simulated live load twice its rated live load.

1. Pre-Test Requirements

   a. Extension platform is extended and secured in position.

   b. Chamber dock seal is in the retracted position.

2. Detailed Description of Test

   a. Simulate a uniformly distributed live load of 1200 pounds on platform.

   b. Manually revolve the platform around tracking envelope 24-inches in diameter.

3. Desired Results

   a. To determine that the platform will support a load twice its rated live load of 600 pounds with no permanent deformation.

   b. To determine that the platform will satisfactorily track the vehicle and that no interference exists between the platform and chamber structure as tracking occurs.

C. Coupler

Ensure that the coupler can be actuated from the platform, operation is smooth with no binding of components, overcenter locking can be readily effected and that jaws of coupler properly engage the vehicle hard point ball.

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D. Dock Seal

This test is conducted to ensure that either blower will satisfactorily inflate the dock seal, that proper inflation and sealing can be maintained as the vehicle is tracked.

1. Pre-Test Requirements

   a. Extension platform has been adjusted and checked as outlined in Section II. B.

   b. Coupler has been checked as outlined in Section II. C.

   c. Vehicle simulator set up per 79K01512 in position A3 (Ref. Figure 1) and coupled to extensible platform.

2. Instrumentation and Location

   a. Load cells on the vehicle simulator to measure total load applied to the vehicle skin by the dock seal as a result of tracking.

   b. Load cells in the coupler area of the vehicle simulator to measure loads induced by the arm coupler as a result of tracking.

3. Detailed Description of Test

   a. Manually extend and retract dock seal and support rods to maximum/minimum dimensions (Ref. 79K00731). Operation should be smooth with no binding of support rods or interference between dock seal and extensible platform or coupler.

   b. Place vehicle simulator in the center nominal position A0 and inflate dock seal using each blower separately and both blowers simultaneously. Shift positions of shuttle valve and observe dock seal inflation behavior and pressure drop on seal inflation pressure gage. Check all seams for integrity.

   c. Determine dock seal to vehicle contact area and footprint.

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d. Simulate a uniformly distributed live load of 600 pounds on the extensible platform. Move vehicle simulator from center nominal position to positions A1, A2, A3, A4 of motion envelope (Ref. Figure 1). Observe and record the following:

(1) Total force applied to simulator skin by dock seal (not to exceed 600 pounds).

(2) Loads induced into the simulator hardpoint by the arm coupler.

e. De-energize blowers and observe seal behavior and decay time.

4. Desired Results

a. To ensure that each blower will satisfactorily inflate and extend the dock seal.

b. To ensure that proper inflation and sealing can be maintained at extremes of motion envelope.

c. To determine force applied to vehicle skin by dock seal during tracking.

d. To determine loads induced into vehicle hardpoint by the arm coupler.

e. To determine pressure (pound per square inch) exerted on dock seal contact area (calculate using force obtained in 3.d.(1) and area in 3.c. above).

f. To ensure that the dock seal will satisfactorily track without scrubbing the vehicle skin.

E. Pressure Regulating System

The Pressure Regulating System should maintain a positive pressure inside the chamber.

1. Pre-Test Requirements

a. The environmental control system (ECS) has been checked and is operable.

b. The Environmental Chamber is erected to the vehicle.

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c. The pressure regulator louvre doors have been checked by hand for freedom of motion.

d. The dock seal is inflated.

2. Instruments and General Location

a. Manometer, for measuring pressure differential to within .5 inches of water, located inside the chamber.

3. Detailed Description of Tests

a. Adjust the louvre door counter weights to maintain a positive pressure differential inside the chamber when the ECS is in operation.

4. Desired Results

a. A positive pressure should be maintained inside the chamber with the vehicle motionless and the ECS in operation.

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III. ALIGNMENT CHECK

A check should be made to determine if certain basic design considerations are met when the access arm is mounted to the tower. All possible pre-test adjustments should be made at this time. Installation and adjustment shall be made in accordance with Installation Drawing 79K00717 and Operations and Maintenance Manual TM-509.

A. Arm Alignment and Lock Adjustment

When the access arm is positioned properly the arm centerline should be at an angle of 109° 33' (Ref. 79K00717) with the tower hinge mounting surface. After arm alignment is complete, the Arm Extend Lock Assembly should be adjusted in accordance with TM-509.

After vehicle erection, arm alignment and the Arm Extend Lock Assembly shall be readjusted so that the dock seal and extensible platform are in the center nominal position when coupled to the unfueled vehicle.

B. Arm Deflection

With the arm extended, measurements should be made to determine arm deflection at the bottom of chamber/arm tip interface relative to the corresponding point at the hinge, and arm tip elevation. These values shall be as specified by the Installation Drawing 79K00717 and Operations and Maintenance Manual TM-509.

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IV. ARM RETRACTION

Arm retraction and extension are accomplished by hydraulic pressure applied to the rotary actuators in the upper and lower hinge. Time intervals shall be regulated by adjusting the hydraulic return valve. There should be no uncontrolled arm retraction or extensions.

These tests are conducted to ensure that all hinge and associated retract/extend equipment works properly in relation to one another and to establish retract/extend time intervals.

NOTE

RETRACTION AND EXTENSION TESTS MUST BE CONDUCTED OUTSIDE OF THE VAB.

A. Shock Absorber Adjustment

The tower mounted shock absorbers determine the stopping point for the access arm on retraction. The arm should be slowly rotated into the shock absorbers with enough force to completely collapse them. By adding shims under the arm striker plate, the fully retracted position of the arm can be adjusted toward the extended direction. The fully retracted position of the access arm should be such that its horizontal axis is parallel to the tower face or within two degrees toward the extended position. The angle and limits of rotation can be set up and read directly from the arm position sensor in the hinge; however, for the accuracy needed in aligning the arm, the position should be verified by measurements from the tower face. Once the arm motion limits have been established, a check should be made to verify that the rotary actuators do not bottom out at the extreme positions of the service arm.

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B. Arm Retraction/Extension

1. Pre-Test Requirements

   a. Alignment checks and adjustments have been completed as outlined in Section III and IV. A.

   b. Extension platform is retracted.

   c. Dock seal is deflated and retracted.

   d. Hydraulic locks are unlocked.

   e. Valve A60140-6A is closed.

2. Detailed Description of Test

   a. With the hydraulic supply at nominal operating pressure, retract the arm at a very slow speed by slowly opening valve A60140-6A.

   b. Slowly extend arm by adjusting valve A60140-6A.

   c. Actuate hydraulic locks.

3. Desired Results

   a. Ensure proper mechanical and hydraulic hinge operation and determine that shock absorbers and latch back mechanism are operating properly.

   b. Determine if, after extension of arm, the arm extended locks engage properly and maintain pre-set position.

   c. Determine if flexible lines across hinge are bending properly.

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V. REPORTS REQUIRED

There should be two types of reports written as a result of the service arm tests. One is a memo report written immediately any time there is a major failure and the other is the final report for each arm.

The memo report should contain all pertinent information concerning the failure. This information should include the test being run, all pressure settings and conditions, reduced data from instrumentation and photographs of damage. The reason or reasons for the failure will be stated.

The final report for each service arm should contain statements concerning all desired results. The operating pressures determined from the test will be given and enough recorded data included in the report to substantiate their selection.

CONTINUATION SHEET

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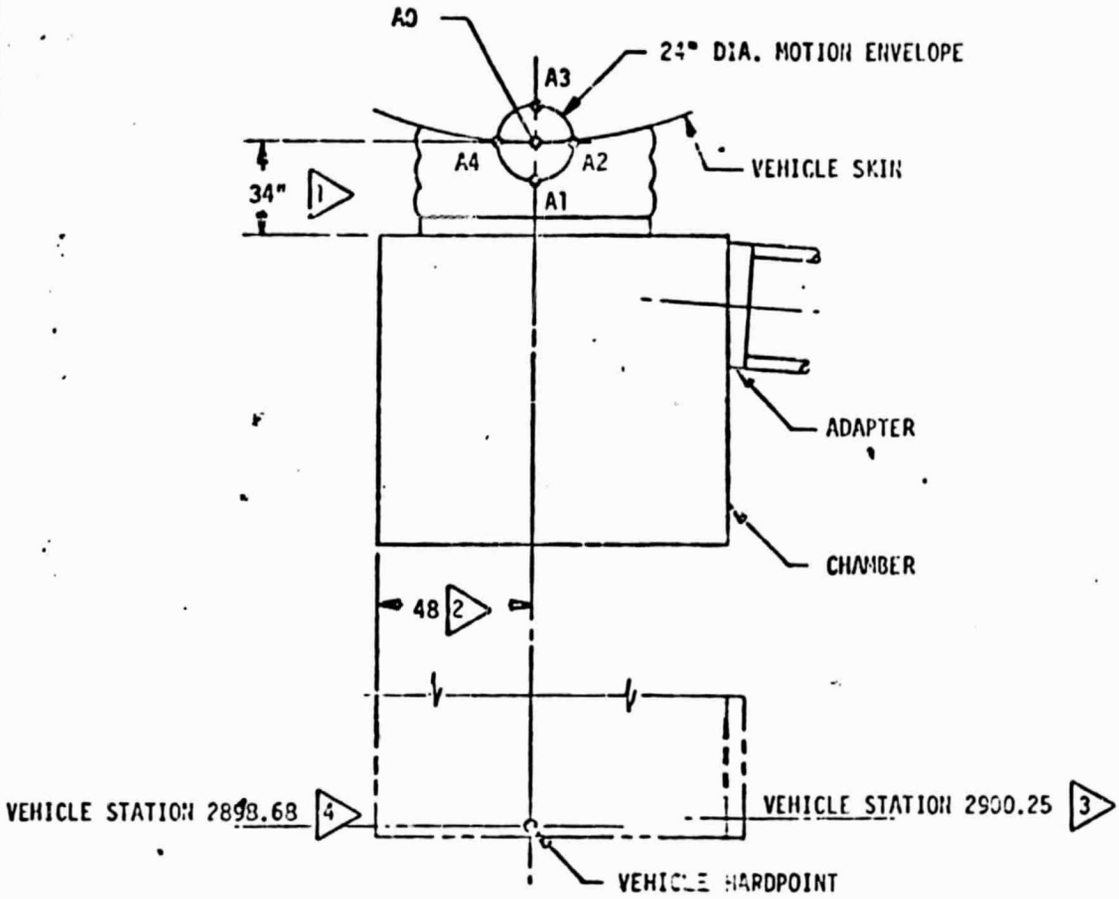

NOTE

1. Nominal distance from face of chamber to vehicle skin along hardpoint centerline.
2. Nominal distance from edge of chamber to centerline of vehicle hardpoint.
3. Vehicle station dimension at the centerline of the service arm bottom chord.
4. Vehicle station dimension at the hardpoint centerline.

FIGURE 1

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REFERENCES

1. System Installation, SVWS Side Access Arm, 79K00717.

2. Technical Manual, Apollo/Saturn V, Launch Complex 39, Mobile Launcher Service Arms, Operations and Maintenance, Command Module Access Arm, TM-509, 22 December 1969 and Addendum 1.

3. Mechanical Installation, SVWS Side Access Arm, Environmental Chamber, 79K00731.

4. Test Fixture Set-Up, SVWS Side Access Arm, 79K01512.

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GROUND SUPPORT EQUIPMENT
ENGINEERING ORDER

(Contractor's Doc. No.)
EO1-79K00069

2. Sheet 1 of 1 sheets

3. EFFECTIVITY (Serial or Unit No.)

4. DISPOSITION OF OLD PARTS (Check one)
[ ] SCRAP [ ] REWORK [ ] USE [ ] NOT APPLICABLE

5. TITLE OF DRAWING
TEST CRITERIA FOR SVWS ACCESS ARM
SKYLAB I

6. REASON FOR CHANGE
TO CORRECT DOCUMENTATION DISCREPANCIES

7. DESCRIPTION OF CHANGE
ON SHEET 13 CHANGE DISTANCE FROM FACE OF CHAMBER TO VEHICLE SKIN ALONG HARDPOINT CENTERLINE
FROM: 34"
TO: 31.70"

FIND NO.	MFR. CODE	DWG. SIZE	PART NO.	DWG. REV.	ACTION	QUAN	UNIT WT.	REMARKS

8. SIGNATURES

REQUESTER	DATE	DRAFTSMAN	DATE
STRESS	DATE	ENGINEER	DATE 7-13-71
CHECKER	DATE 7/14/71	APPROVED BY DD-MDD-3	DATE 8-3-71

RSC FORM 21-36 (REV 6/64)

GROUND SUPPORT EQUIPMENT ENGINEERING ORDER

1. ENGINEERING ORDER NO. (Prefix followed by Eng. No.): 2-79K00069

2. Sheet 1 of 1 sheets

3. EFFECTIVITY (Vehicle & vehicle):

4. DISPOSITION OF OLD PARTS (Check one): ☐ SCRAP ☐ REWORK ☐ USE ☐ NOT APPLICABLE

5. TITLE OF DRAWING: TEST CERTIFICATION SWWS ACCESS ARM SKYLAB 1

6. REASON FOR CHANGE: ADDS STEP TO CONNECT EXTENSIBLE PLATFORM

7. DESCRIPTION OF CHANGE:

CHANGE PARAGRAPH 3.d. ON SHEET 7 TO READ AS FOLLOWS:

d. CONNECT EXTENSIBLE PLATFORM TO VEHICLE HARDPOINT AND SIMULATE A UNIFORMLY DISTRIBUTED LIVE LOAD OF 600 POUNDS ON THE EXTENSIBLE PLATFORM. MOVE VEHICLE SIMULATOR FROM CENTER NOMINAL POSITION TO POSITIONS A1, A2, A3, A4 OF MOTION ENVELOPE (REF. FIGURE 1).

OBSERVE ----------

FIND NO.	MFR. CODE	DWG. SIZE	PART NO.	DWG. REV.	ACTION	QUAN	UNIT WT.	REMARKS

8. SIGNATURES

REQUESTER	DATE	DRAFTSMAN	DATE
STRESS	DATE	ENGINEER L. V. Cook	DATE 2/17/72
CHECKER	DATE	APPROVED BY DD-MDD-3	DATE 2/18/72

RDC FORM 21-04 (REV 2/64)

NASA-PAS B JUL '70

GROUND SUPPORT EQUIPMENT
ENGINEERING ORDER

3-79K00069

Sheet 1 of 1 sheets

3. EFFECTIVITY

4. DISPOSITION OF OLD PARTS: ☐ SCRAP ☐ RETURN ☐ USE ☐ NOT APPLICABLE

5. TITLE

TEST CRITERIA FOR SVWS ACCESS ARM SKYLAB 1

6. REASON FOR CHANGE

ADDS STEP TO OBTAIN DESIRED RESULTS OF PARA. 4.c.

7. DESCRIPTION OF CHANGE

1. CHANGE PARAGRAPH 3.d.1 ON SHEET 7 AS FOLLOWS:

WAS (1) TOTAL FORCE APPLIED TO SIMULATOR SKIN BY DOCK SEAL (NOT TO EXCEED 600 POUNDS).

IS (1) TOTAL FORCE APPLIED TO SIMULATOR SKIN BY DOCK SEAL AND PLATFORM BUMPER.

2. CHANGE PARAGRAPH 3.e AND ADD PARAGRAPH 3.f ON SHEET 7 AS FOLLOWS:

WAS e. DE-ENERGIZE BLOWERS AND OBSERVE SEAL BEHAVIOR AND DECAY TIME.

IS e. DISCONNECT COUPLER FROM HARDPOINT. WITH ONLY DOCK SEAL INFLATED, MOVE VEHICLE SIMULATOR FROM CENTER NOMINAL POSITION TO POSITIONS A1, A2, A3, A4 OF THE MOTION ENVELOPE. OBSERVE AND RECORD TOTAL FORCE APPLIED TO THE SIMULATOR SKIN BY THE DOCK SEAL (NOT TO EXCEED 600 POUNDS).

f. DE-ENERGIZE BLOWERS AND OBSERVE SEAL BEHAVIOR AND DECAY TIME.

FIND NO.	MFR. CODE	DWG. SIZE	PART NO.	DWG. REV.	ACTION	QUAN	UNIT WT.	REMARKS

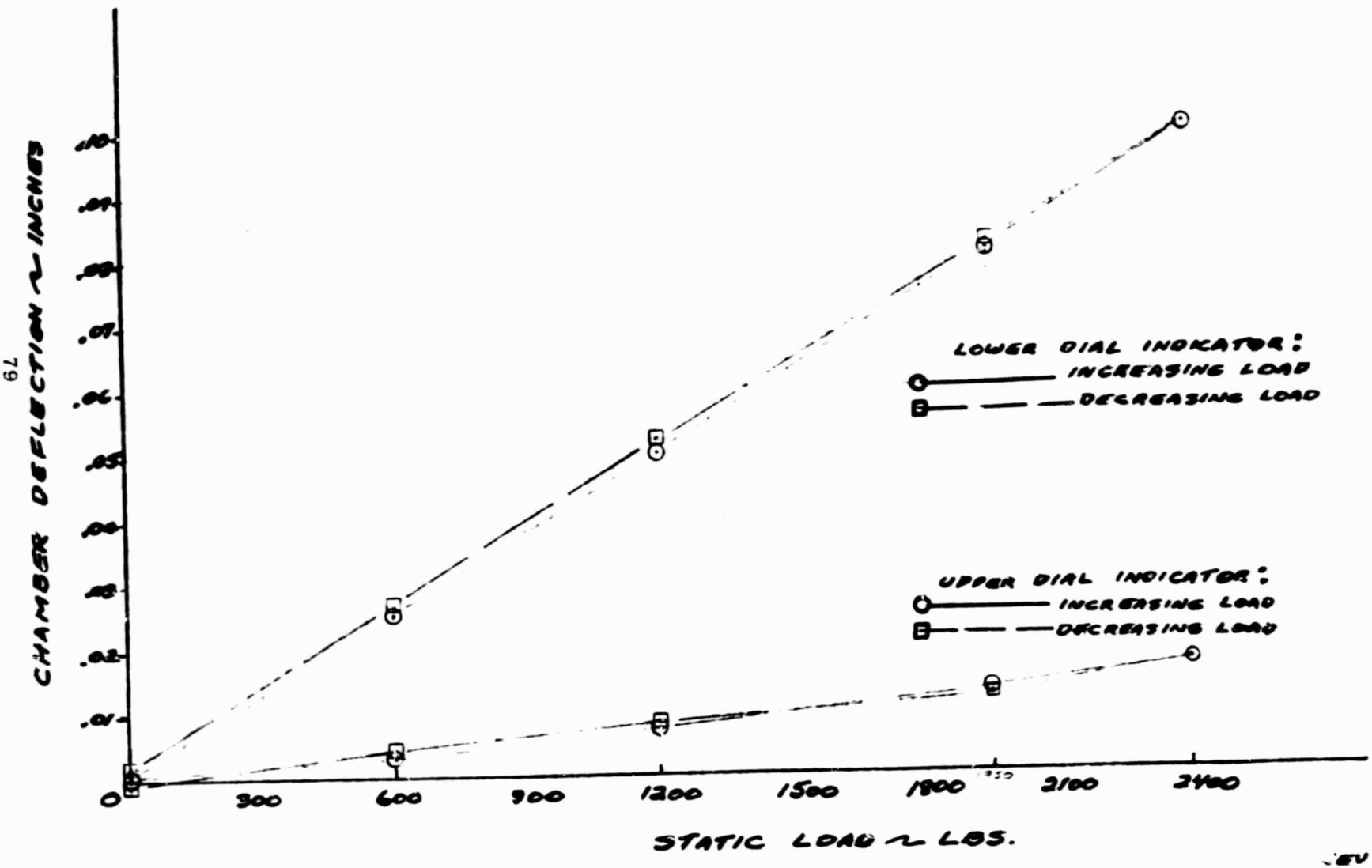
8. SIGNATURES

REQUESTER	DATE	DRAFTSMAN	DATE
STRESS	DATE	ENGINEER L. V. Cook	DATE 2/22/72
CHECKER	DATE	APPROVED BY	DATE 2/22/72

NSC FORM 21-26 (REV 8/64)

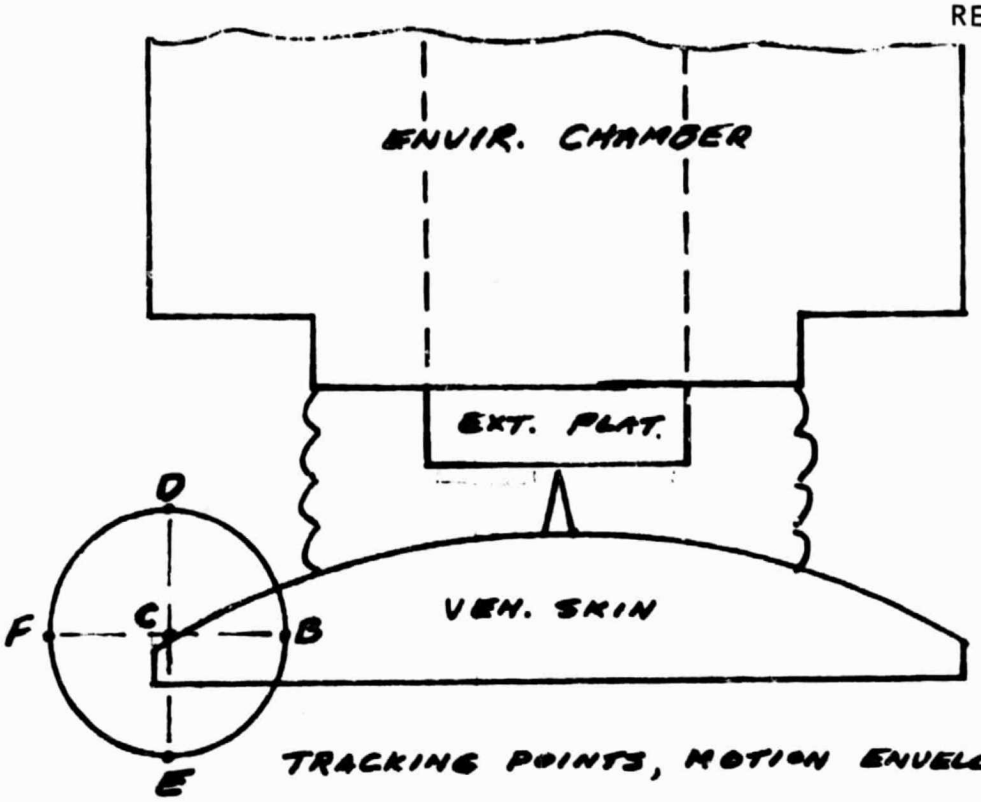
NASA-HAB JUL '70

S/A 6A ENVIRONMENTAL CHAMBER LOAD TEST
TEST CONDITIONS ~ ATP-001

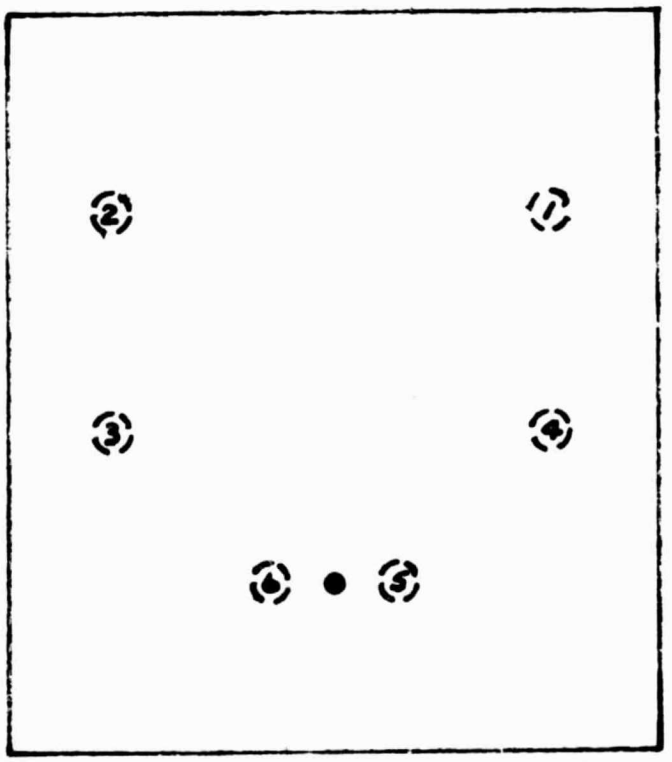


REFERENCE "C"

EV 4/3/72



TRACKING POINTS, MOTION ENVELOPE



LOAD CELL IDENTIFICATION
VIEWED FROM FRONT OF VEH. SKIN

SERVICE ARM LA ENVIRONMENTAL CHAMBER TEST

LOAD CELL DATA SHEET

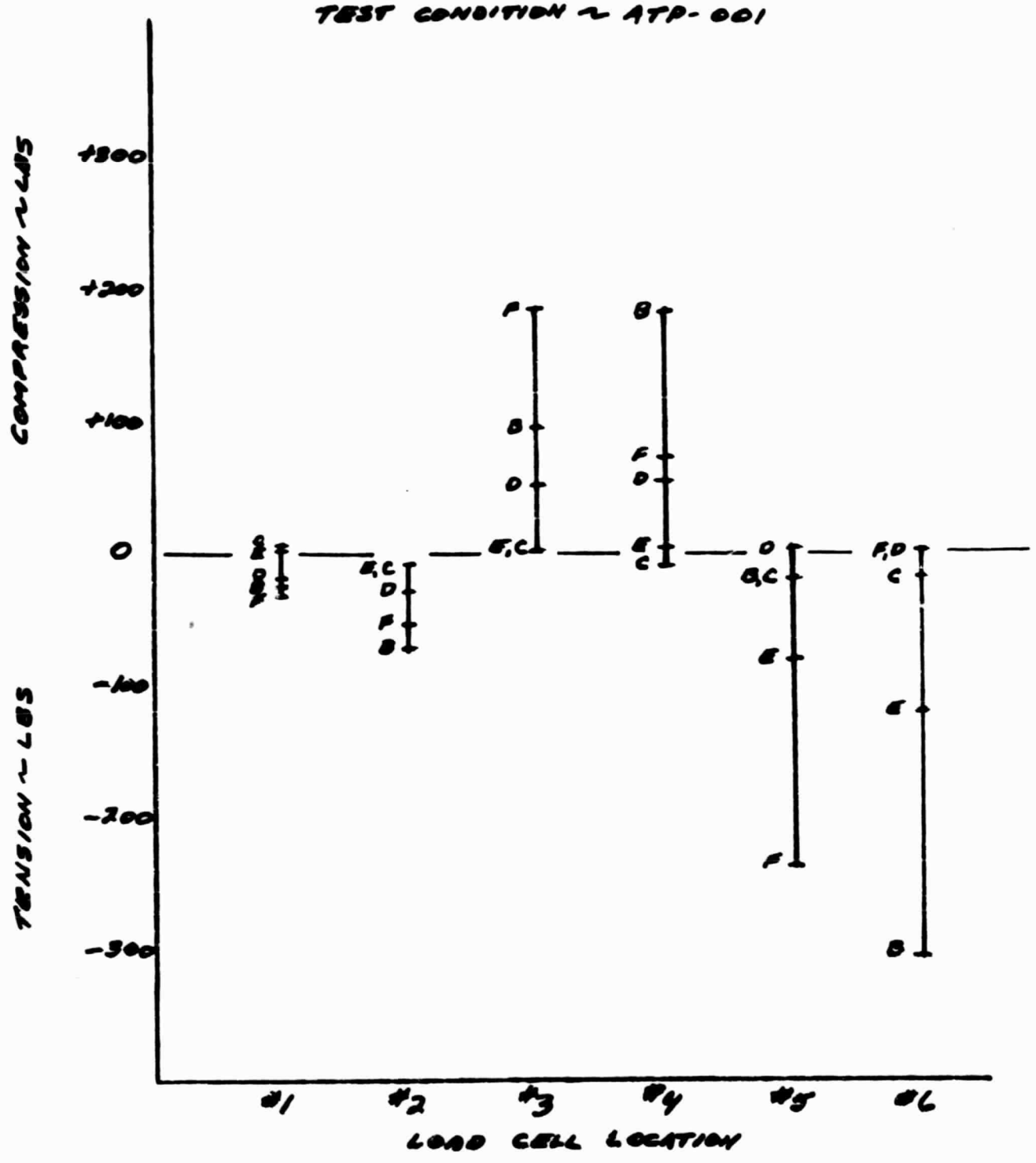
TEST CONDITION ~ ATP-001	PROCEDURE ITEM NO.	#1	#2	#3	#4	#5	#6
BLOWER #1 ONLY	8.4.12.1	+50	+35	+40	+35	-20	-10
BLOWER #2 ONLY	8.4.13.1	+50	+40	+40	+35	-20	-10
BOTH BLOWERS	8.4.14.1	+50	+40	+35	+30	-20	-10
EXT. PLAT. WITH 600# LOAD							
POINT "C", NEUTRAL	8.4.20	+5	-10	0	-10	-30	-20
POINT "D", FORWARD	8.4.21	-15	-30	+80	+55	0	0
POINT "E", AFT	8.4.21	0	-10	0	0	-80	-120
POINT "B", LEFT	8.4.21	-25	-70	+95	+110	-20	-305
(ELIMINATED PLAT. SKEW)		-15	+10	-20	+20	-128	+85
REPOSITION FORKLIFT, CK PT. "C"		+35	-35	+20	-40	-20	-20
POINT "F", RIGHT	8.4.24	-80	-60	+135	+70	-235	0
LOADED PLAT., BOTH BLOWERS "ON"							
POINT "C"	8.4.26	+70	0	+90	+10	-15	-20
POINT "F"	8.4.26	0	-15	+240	+60	-225	+20
POINT "D"	8.4.26	+100	+80	+140	+60	+5	0
POINT "E"	8.4.26	+80	-10	+60	+5	-80	-100
REPOSITION FORKLIFT, CK PT. "C"		+40	+40	+35	+40	-25	-30
POINT "B"	8.4.26	+20	-40	+115	+200	+10	-305
POINT "C", RECHECK MEAS.		+30	+40	+60	+20	-30	-10

Rev 4/26

VEHICLE SKIN PANEL LOAD DISTRIBUTION

(EXTENSIBLE PLAT. WITH 600 LBS LOAD)

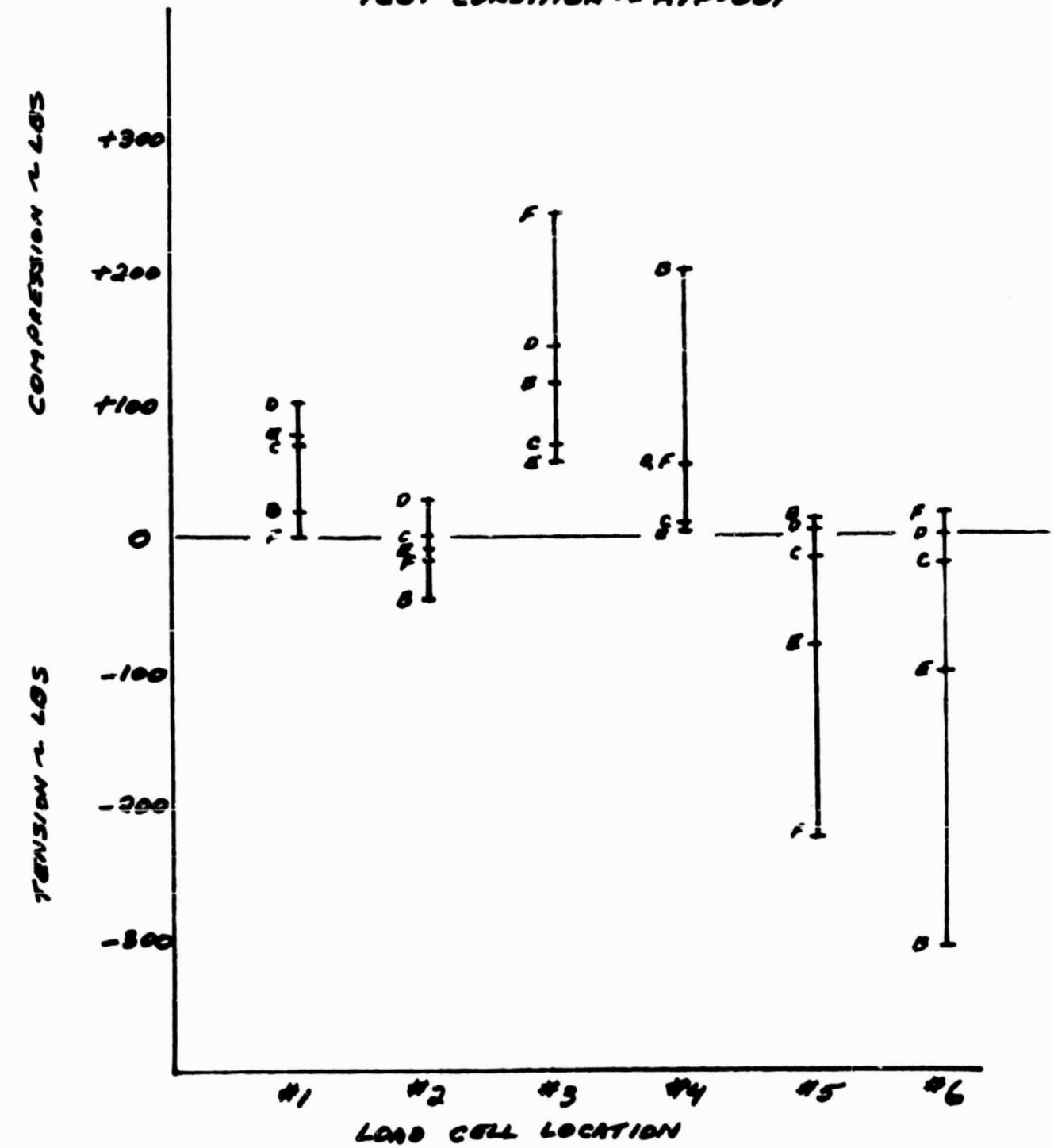
TEST CONDITION ~ ATP-001



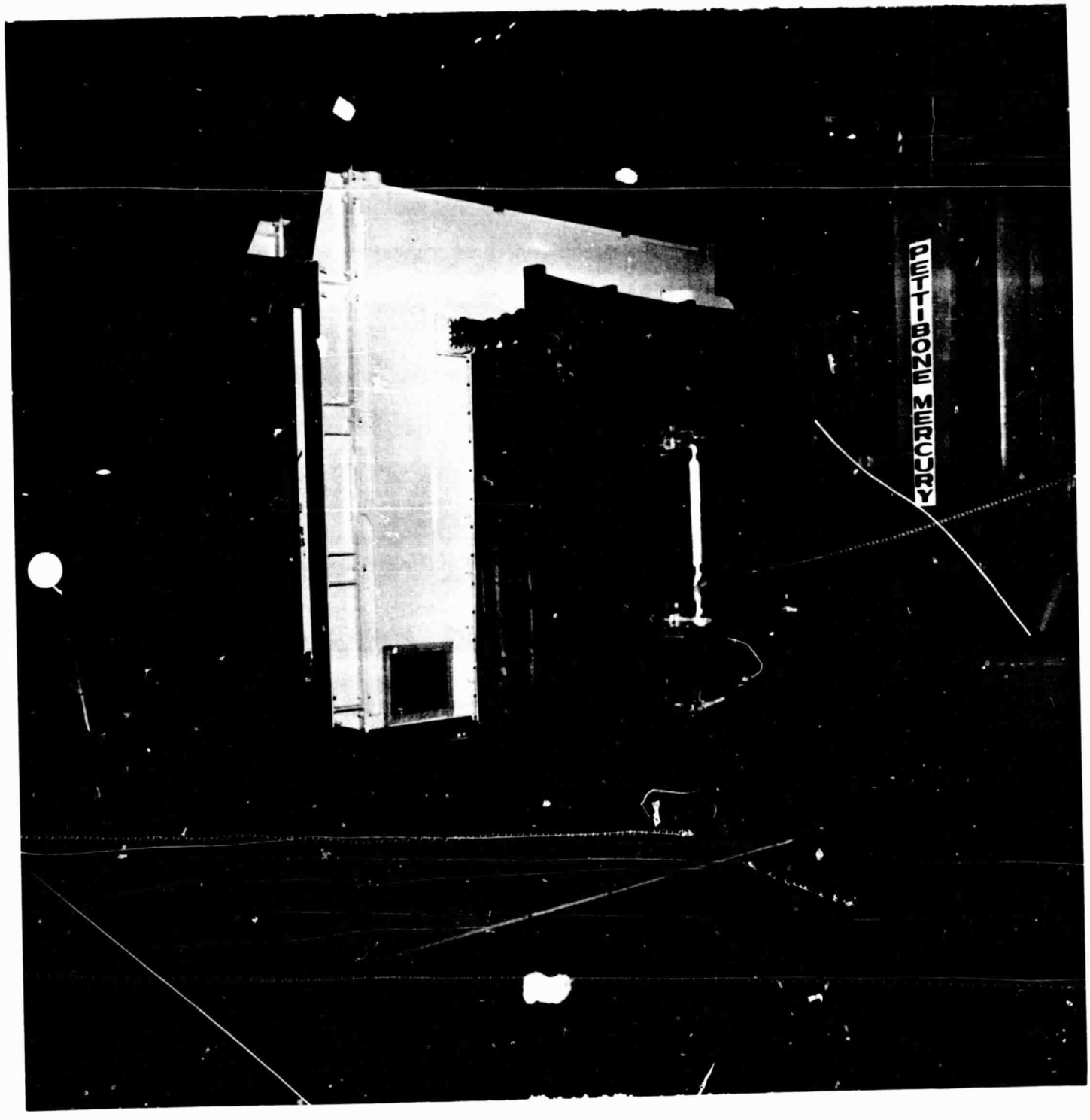
JSV 4/24

VEHICLE SKIN PANEL LOAD DISTRIBUTION

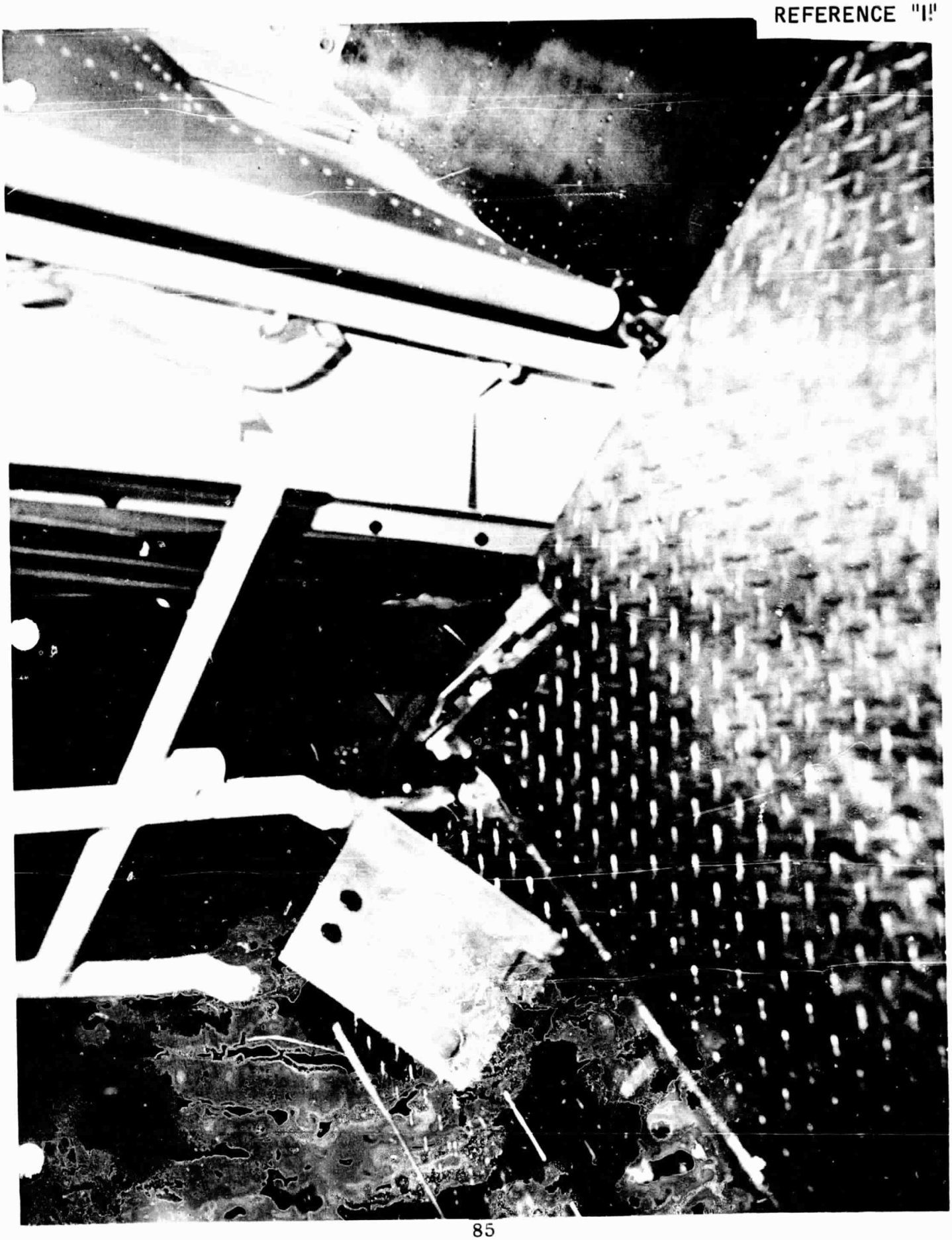
(EXT. PLAT. WITH 600 LB. LOAD AND BELLOWS SEAL INFLATED, BOTH BLOWERS)
TEST CONDITION ~ ATP-001



JEU 4/26


PETTIBONE MERCURY

REFERENCE "I"



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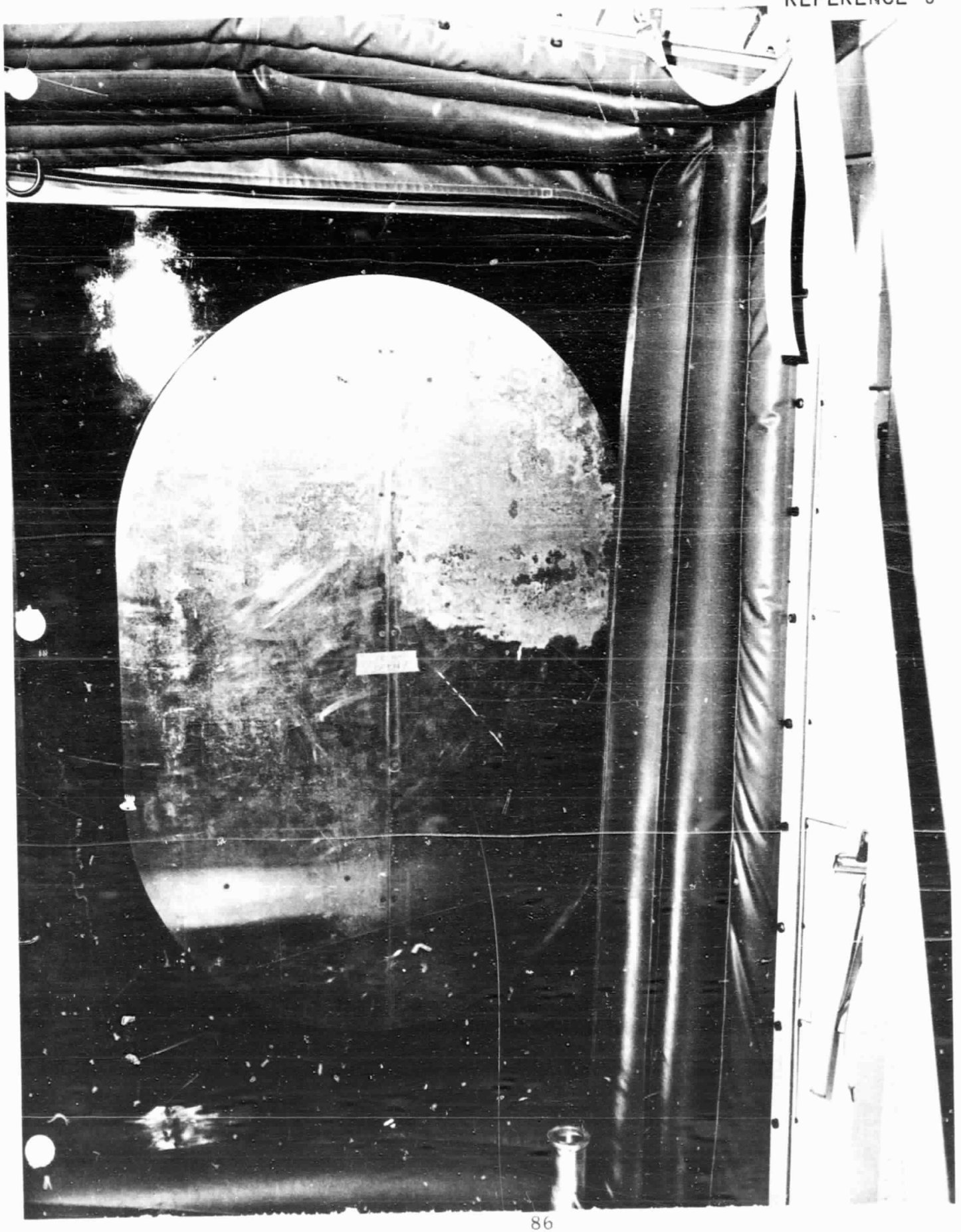
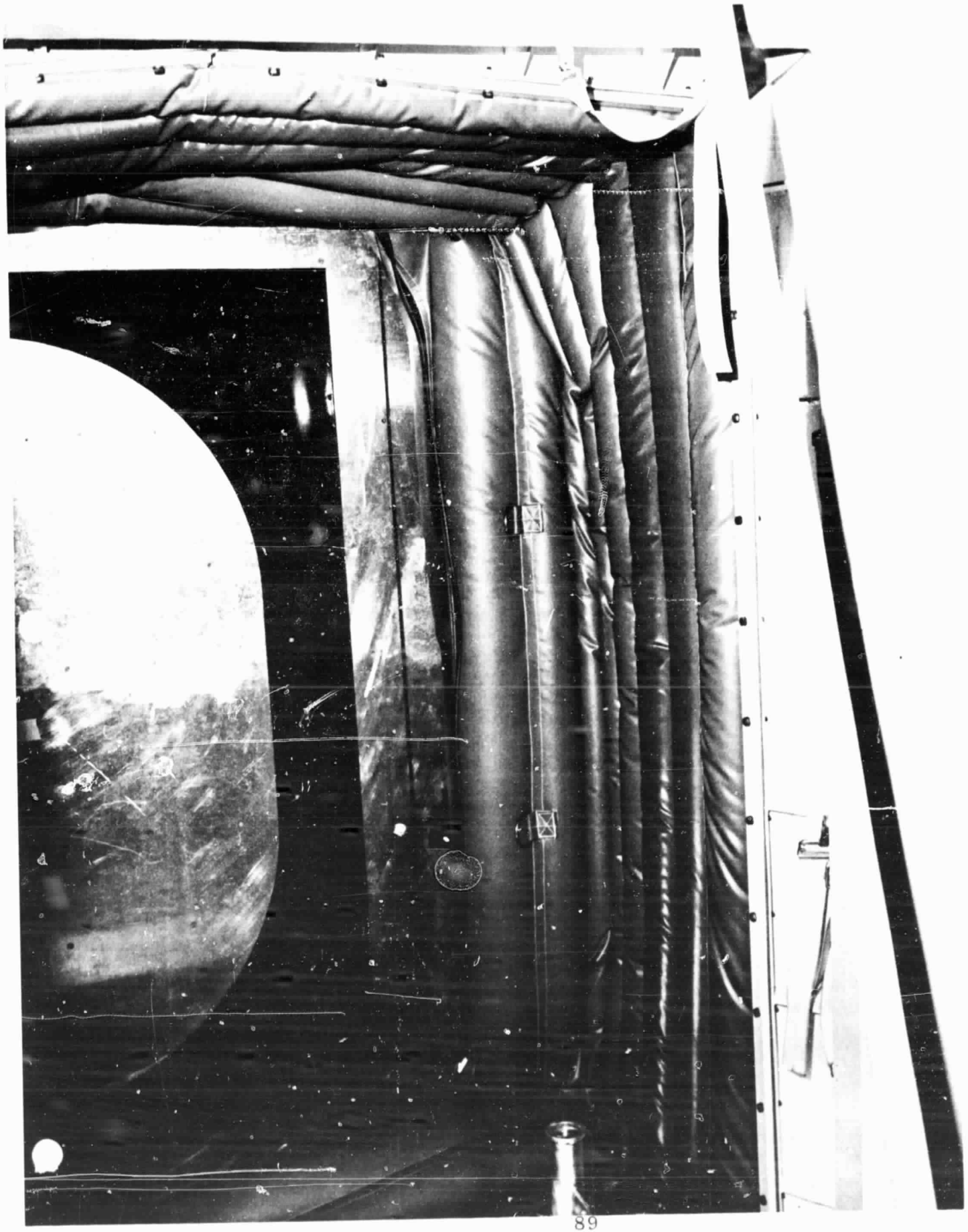
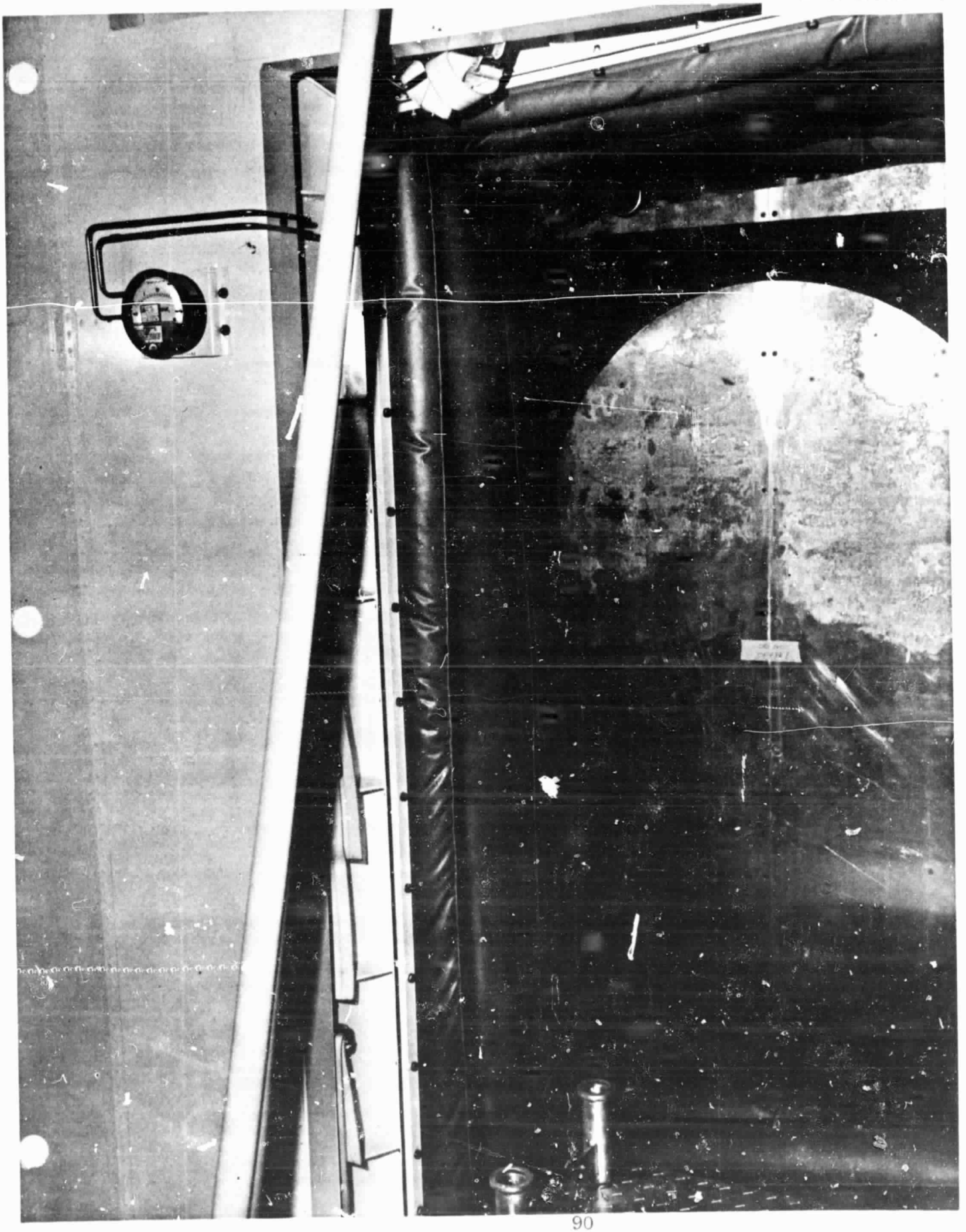
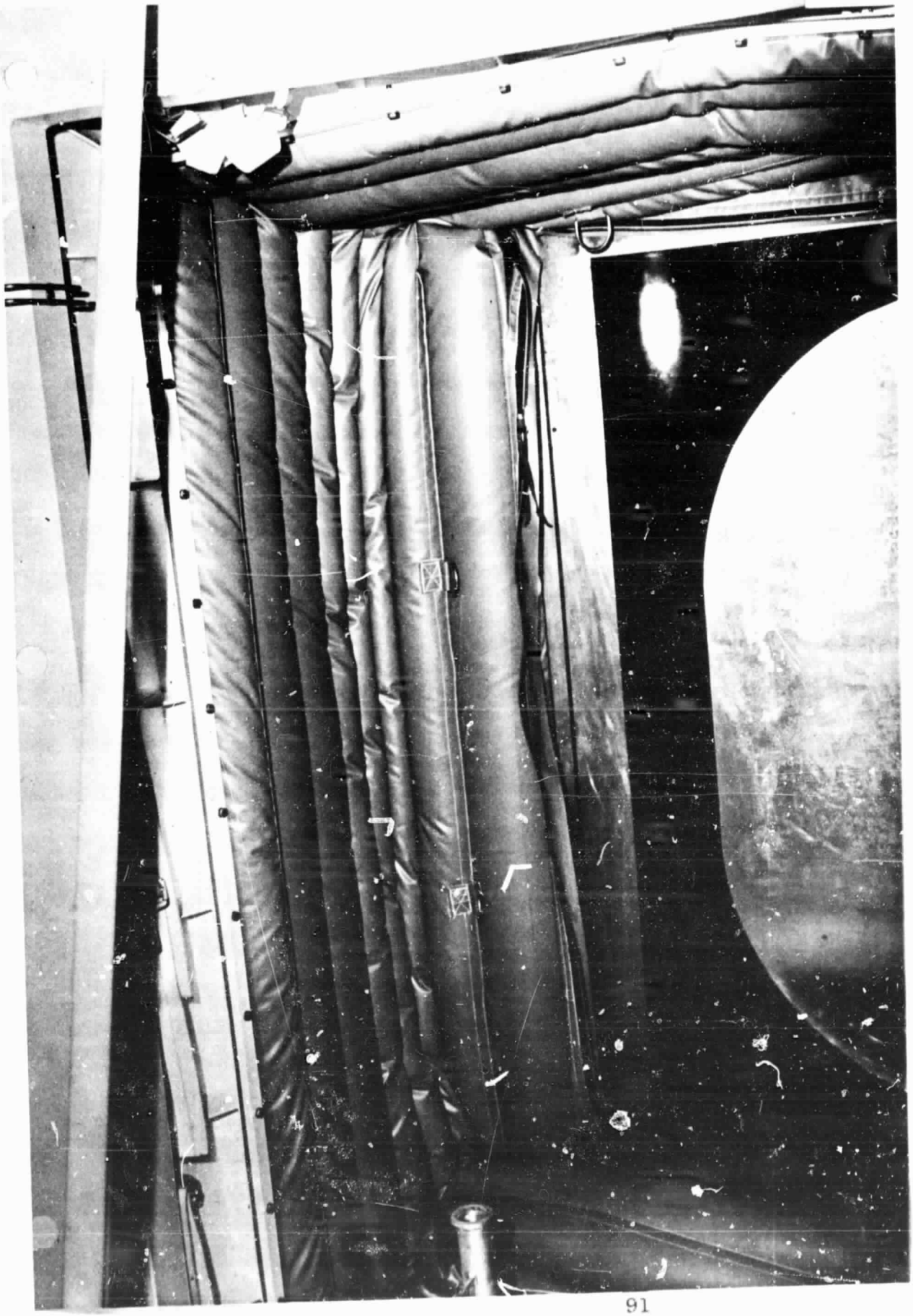


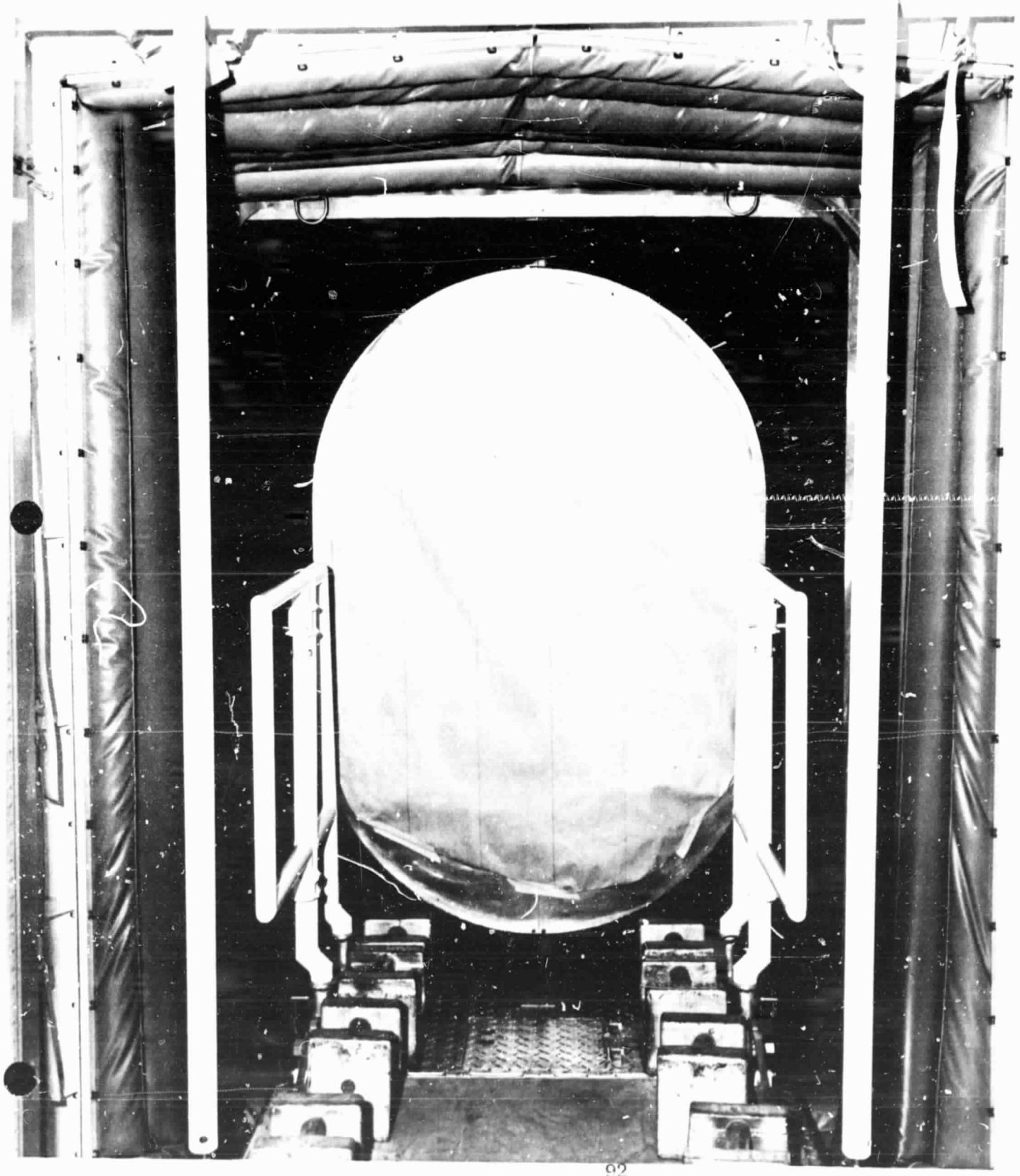
REFERENCE "K"

REFERENCE "L"

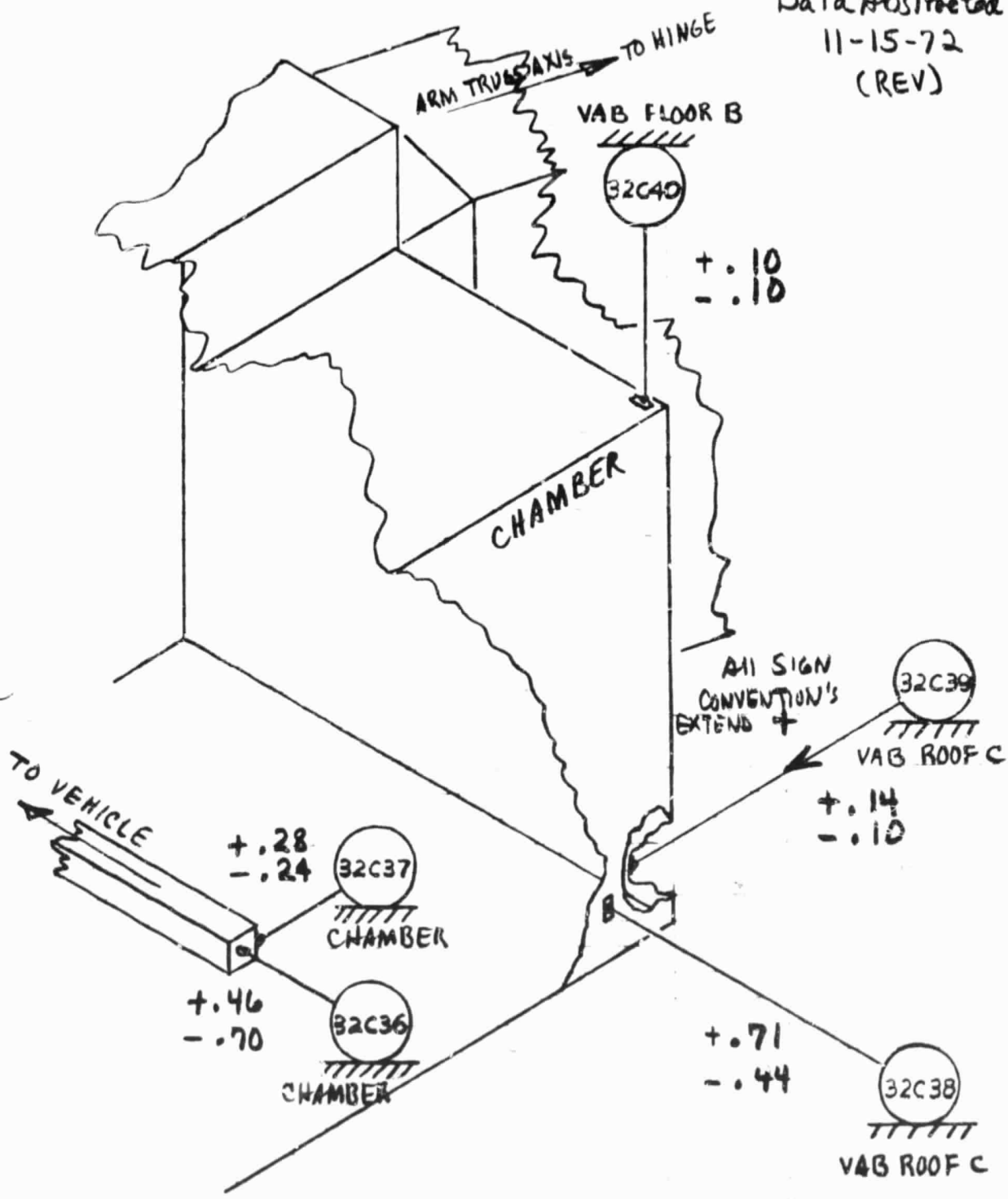








Data Abstracted
11-15-72
(REV)



Appendix B

ENCLOSURE 1